Muskrat Dam Hydro Development

Ontario

Ministry of Energy

Honourable Philip Andrewes Minister

Energy Ontario

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MUSKRAT DAM HYDRO DEVELOPMENT

Preliminary Feasibility Study

and

Environmental Assessment

1983

Prepared For

THE ONTARIO MINISTRY OF ENERGY

By

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Ontario Ministry of Energy
Honourable Philip Andrewes
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Energy Ontario

Foreword

The Ministry of Energy would like to point out that the following feasibility study has taken into consideration all possible contingencies in the preparation of the final cost estimate. Therefore, the real cost to install a system may be significantly lower than that quoted. In fact, other sources have estimated that the real costs could be half of the figures given.

EXECUTIVE SUMMARIES

Preliminary Feasibility Study

The purpose of this study is to review the feasibility of developing a power facility to provide hydroelectric power for the Muskrat Dam Community.

A power facility consisting of two 100 kW Mini Hydel Stations would be installed at the end of a canal across a peninsula on the right bank of the Windigo River approximately one kilometer upstream of Muskrat Dam Lake.

Two transmission alternatives were investigated: (i) a direct route from the power plant to the community including a submarine cable across Muskrat Dam Lake and (ii) an all overhead line around Muskrat Dam Lake to the community.

Cost estimates were prepared to indicate order of magnitude costs for the power facility and the transmission line alternatives. The estimated cost for the development of the power facility including distribution to individual residents via the use of a submarine cable across Muskrat Dam Lake with a second back-up cable is estimated to cost $2,480,000. The estimated cost for the power facility including distribution via use of an overhead transmission line around Muskrat Dam Lake is estimated to be $2,730,000. All costs are shown in November 1982 Canadian dollars.

A report assessing the environmental impact of the project on the area accompanies the Preliminary Feasibility Study.

Environmental Assessment

A mini-hydro development has been proposed to supply electricity to a remote Indian community, Muskrat Dam, located on Muskrat Dam Lake in the northwest corner of Ontario. Feasibility studies have identified a suitable location for development of a run of river mini-hydro plant on the Windigo River at a site approximately six kilometers southeast of the Muskrat Dam community. The proposed development will consist of a headrace canal across a peninsula leading to two prefabricated Mini-Hydel Plants which will produce a total of 200 kW power. Two power transmission corridors have been examined, one of which requires a submarie cable crossing of Muskrat Dam Lake. A separate report describing the feasibility of the mini-hydro development has been prepared by Monenco Ontario Limited (1983).

The Muskrat Dam community is currently not electrified. Private generators supply power for the community's schools and for the toll telephone. A native-operated fish packing plant and sawmill in the community also have diesel generated electricity, but it is an undependable source and restricts the plant's operating capacities. The community has no public facilities except for a health clinic, but desires to develop recreational, and water and sewage facilities. The Band Council supports electrification because of the increased standard of living, economic benefits and growth potential which will result. However, the community desires to be involved in all phases of the proposed development to insure maximization of benefits and compatibility with the community's future growth aspirations.

In 1982 Muskrat Dam had an Indian population of about 186 people. The community is isolated; the only access is by float plane or by winter road from Pickle Lake, approximately 240 kilometers to the southeast. Muskrat Dam is a family-oriented community with over 90 per cent of the adult population engaged in gainful employment. No alcohol related problems exist in the community and welfare constitutes only a secondary source of income for most families. Seasonal commercial activities such as fishing, trapping, transportation and sawmilling generate the majority of the community's wage income. The natives are very dependent on the abundant regional natural resources to supply most of their food and energy requirements. The economic quality of life at Muskrat Dam is a balanced mixture of traditional resource gathering activities and modern livelihoods. Nevertheless, the community desires to increase its economic base and provide better and varied employment opportunities for the young adult population.

It is expected that installation of the proposed hydro development will provide long term benefit to the Muskrat Dam community and increase their overall standard of living. The project is planned with an add-on capability which can be developed as community demand and economics warrant. The 1979 community power requirement forecast was estimated at 114 kW. The excess power from the proposed development can be used to diversify or improve the community's economic sector, and to increase public services. The construction phase of the project can employ a large number of the adult males from the community at significantly higher wages for a 3 to 4 month period which, if properly planned and coordinated, could increase community income. A full time/part time position will exist for one individual during the hydro plant operation for servicing and maintenance. Some part time employment positions may occur on a periodic basis for brush clearing along the transmission corridor.

Some potential negative impacts are also associated with the proposed development, mainly of a social and economic nature during the construction phase. However, since the project construction is expected to be completed over a period of three to four months in spring and summer it is expected that most negative impacts will be temporary and readily mitigated through proper planning and management. It is expected that an in-migrant skilled labour work force of about 20 individuals will be required during the construction phase. The potential temporary negative socio-economic impacts are considered to be local job displacement (mainly fisheries and sawmill/construction operation), local inflation, temporary depression at loss of high wage earning employment, interference with traditional resource gathering activities, and the possibility of tension developing between the local native community and the in-migrant work force. Environmental impacts on aquatic and terrestrial biota are expected to be of short duration and relatively insignificant. It is considered that the project area is a region of high archaelogical potential; hence, the construction areas and transmission corridors should be examined to evaluate areas of sensitive heritage resources which may be adversely affected by the proposed development.

In order to insure adequate mitigation of potential negative impacts, and to insure the proposed development is compatible with the future aspirations of the Muskrat Dam community, a number of areas of particular sensitivity and local importance are identified and recommendations for their further study are presented. It is recommended that direct community involvement should be inititated in conjunction with any further planning effort regarding the proposed project. It is also recommended that project employment requirements be defined so that native involvement and the impact of temporary job displacement on the local economy can be better evaluated. A current forecast of community energy requirements should be conducted to evaluate the present and future community needs in conjunction with planned community developments. A site location analysis should be conducted to avoid locating the construction camp and power plant in sensitive areas where heritage resources or natural resources may be adversely affected. Consideration should be given to locating the construction camp in an area isolated from the Muskrat Dam community and prohibiting in-migrant workers from visiting the community to minimize the potential for the development of tensions and negative community reaction. A brief on-site survey of fishery resources is recommended to confirm that anticipated impacts from the proposed development will be negligible. It is recommended that a monitoring committee be formed to report on the various environmental and socio-economic aspects of the project to insure mitigation of negative impacts and maximization of community benefits.

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PRELIMINARY FEASIBILITY STUDY

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1.0 INTRODUCTION

In accordance with the agreement dated July 27, 1982, a feasibility review of developing a small hydro facility to supply hydro-electricity to the remote community of Muskrat Dam in Northern Ontario has been completed.

An earlier report (1) prepared by Ontario Hydro in 1979 provided the basis for the study. The project site was not inspected. All geologic, topographic data as provided in the above report was accepted for purposes of this study.

The development of a small hydro facility at Muskrat Dam would consist of installing 2-100 kW Mini-Hydel Stations with an integrated concrete headworks at the end of a 60 m long canal cut in the rock extending across the peninsula.

2.0 BACKGROUND DATA

Muskrat Dam is a relatively new community approximately 225 km north of Pickle Lake as shown on Plate 1. The village is on a peninsula projecting into the northwest portion of Muskrat Dam Lake, on the Severn River system. The population of the community was 173 as of August 1978.

There is no central power supply for the community although privately-owned diesel generators service facilities such as the school and nursing station. Based on a restricted residential service, a peak load of 114 kW was estimated as per the Ontario Hydro Report.

The above report indicated satisfactory field conditions for siting a hydro generating station on the Windigo River at the confluence of the Severn River. A review of the available hydro-logic data indicated a power potential far in excess of that required by the community for restricted service.

(1) "Severn River Muskrat Dam Community/Windigo River Power Site Feasibility Analysis"; as prepared by Ontario Hydro, dated November 1979.

3.0 DESCRIPTION OF DEVELOPMENT

3.1 LOCATION

The power site would be located on a peninsula on the right bank of the Windigo River approximately one kilometer upstream of the outlet to Muskrat Dam Lake.

3.2 CANAL AND TAILRACE

The canal, to be cut in rock, will be about 60 m long and 4 m wide. A design flow velocity not exceeding 0.5 m/s was selected in order to ensure the formation of a stable ice cover during the winter. A dissertation on canal design is included in Appendix A. A short tailrace, also cut in rock, would return the flow to the downstream river. Maximum depth of rock excavation is expected to be about 6 m.

3.3 INTAKE

As shown on Plate 2, reinforced concrete intake structures are provided immediately upstream of the power facilities. Each intake would be provided with a trashrack and a bulkhead gate and lift. Stoplog guides would be provided immediately upstream of each bulkhead gate. Only one set of timber stoplogs would be provided as they would be interchangeable. A pre-engineered building would be provided to house the entire intake and power facility.

Stoplogs are provided in the event the gate should require repair or maintenance. The inclusion of a shelter over the facility is to protect the gates and lifts from the elements, to store miscellaneous equipment such as the stoplogs, and to provide a protected work area around the facility during inclement weather.

3.4 POWERHOUSE

The power facility would consist of two 100 kW Mini-Hydel Stations such as manufactured by Barber Hydraulic Turbine. Each station would include a self-contained generating unit package complete with control and protection equipment. Two units have been selected instead of one, in order to provide a measure of reliability for the following reasons:

- If one unit shuts down due to a fault, servicing and repair are likely to be time-consuming, requiring at least several days, perhaps a week to obtain parts to correct the fault;

- Although hydro units can be relied upon to provide power 90% of the time, a downtime of 10% is equivalent to no power for about one week every two months. Such a lack of power cannot be tolerated, particularly during winter months;

- During winter, ice runs in the river will cause considerable problems at the intake due to blockage with ice floes. During such periods, a unit will have to be shut down while the intake is manually cleaned of ice accumulation, and the supply of power will have to alternate between the two units.

Two units of 100 kW capacity have been selected, so that one unit can provide almost the full power requirements of the community. Smaller units would require a severe cut in power demand during single unit operation, and larger units could only be justified by a relatively large future load growth.

The Mini-Hydel Stations are modular self-contained units which are easily transported to site. The equipment is designed to require a minimum of on-site civil engineering, mechanical and commissioning work. A pre-engineered building will cover the power units and intake to proviude an enclosed working space to facilitate maintenance and repair of the equipment in winter.

4.0 DISTRIBUTION SYSTEM

4.1 GENERAL

This section of the report reviews the distribution system requirements to transport power from the proposed generating station to the load center of Muskrat Dam and to distribute this power throughout the community.

Actual site conditions are not known; therefore, this review is based solely on the use of available topographic maps. If a decision is made to proceed with this project then the line route selected will have to be carefully reviewed in the field prior to making any final commitments.

The switchyard would be located adjacent to the powerhouse. The distribution line would be terminated at the switchyard through a recloser equipment with isolating disconnect switches. A fused by-pass switch would also be provided to permit maintenance of the recloser without interruption of the power supply to the community.

It is assumed a standby generator would be provided near the village and adjacent to the overhead distribution circuit as a temporary back up for the loss of the transmission line or cable.

The proposed power system single line diagram is shown on Plate 3.

4.2 TRANSMISSION

Since two 100 kW generating units are proposed, it is recommended that the transmission line be capable of transporting the full 200 kW output of the generating station even though the initial load is estimated at only 114 kW.

A wood-pole three-phase circuit would be required and because of the distance between the proposed powerhouse and the community load center, a minimum voltage level of 4.16 kV is needed to maintain voltage within acceptable limits.

Two alternate routings of the 4.16 kV distribution line have been considered. The first (Alternative I) is the most direct route (7.8 km) as shown on Plate 4, but requires the use of a submarine cable to cross the Muskrat Dam River. The second (Alternative II) avoids the use of the submarine cable, but is considerably longer (15.0 km) (refer to Plate 5). These alternatives are discussed below.

.1 Alternative I

This alternative provides the most direct route from the proposed powerhouse to the community of Muskrat Dam. The use of submarine cable to cross the Muskrat River is not expected to be a problem, however, appropriate cable protection would be needed to avoid cable damage due to ice floes in the river.

Neither the ice conditions nor the depth and condition of the river bed at this location are presently known. It has been assumed, for cost estimating purposes, a depth of about 15 meters and a rock bottom. An allowance for trenching in the rock for a distance of 100 meters (50 meters into the river and 50 meters on shore) on each side of the river is also included in the cost estimate.

.2 Alternative II

It is estimated that 1.5 km of distribution primary and 3.0 km of distribution secondary circuits would be required to distribute the generation throughout the Muskrat Dam community. With an estimated load of 114 kW (about 150 kVA), 350 kVA of distribution transformer requirements are estimated. Each transformer would be equipped with a fused cutout and a lighting arrester.

It is noted that some or all of this distribution system may already be in existence. If this should be the case, the amount allowed for this item in the cost estimate could be reduced or possibly eliminated altogether.

5.0 COST ESTIMATE

The cost estimate shown below was prepared to indicate an order of magnitude cost for the construction of a hydro-electric power facility at Muskrat Dam.

Item Description	Cost
A. Power Generation Facility	
Land and Water Rights	$ -
Preliminary Works	60,000
Diversion Works and Water Control	50,000
Headrace and Headworks	280,000
Powerhouse and Tailrace	90,000
Turbines and Generators	370,000
Miscellaneous Mechanical Equipment	90,000
Miscellaneous Electrical Equipment	50,000
Standby Diesel Generator	70,000
Mobilization, Demobilization and Demurrage	260,000
Temporary Facilities	120,000
Engineering and Management	120,000
Owner's Administration	20,000
General Contingency	240,000
Total Power Generation Facility Cost	$1,820,000
B. O.H. Transmission/Submarine Cable including Distribution - Alternative 1	
Switchyard, Transmission Line, Submarine Cable, Community Distribution	150,000
Engineering and Management	50,000
Owner's Administration	15,000
Contingency	85,000
Total O.H. Transmission/Submarine Cable and Distribution Cost	$ 660,000
C. O.H. Transmission Line Only including Distribution - Alternative 2	
Switchyard, Transmission Line, Community Distribution	730,000
Engineering and Management	50,000
Owner's Administration	15,000
Contingency	115,000
Total O.H. Transmission and Distribution Cost	$ 910,000

The estimated cost is based on the following assumptions:

i) quantities for major cost components, determined from previous experience;

ii) costs for mechanical and electrical installations were based on manufacturer's recent quotations and bid prices for similar sized projects, including allowances for transportation to site and erection;

iii) the bulk of the skilled labour force will come from outside in order to provide the necessary skills Native labour will be employed to the extent possible;

vi) accommodation for the outside labour force and staff will be in mobile trailers; only the local labour force will be housed in the nearby native villages; and

v) the equipment will be brought in at the end of the winter season, over ice bridges, wherever necessary, and will be demobilized during the following winter season. It will, therefore, be necessary to pay demurral charges on the equipment for approximately 10 months.

To reflect additional possible costs due to final location of structures, a contingency adjustment of 15% was made on the total construction and undistributed cost estimate.

The following are not included and are not part of the order-of-magnitude cost estimate:

i) interest during construction;

ii) federal or provincial sales taxes;

iii) land cost of rental;

iv) permits or credits associated with the project;

v) operation and maintenance costs; and

vi) escalation in labour, material and equipment beyond November 1982.

If owner equipment, or machinery which has already been fully depreciated, can be made available at nominal rates, significant cost savings could be achieved.

It is noted that an allowance of $5,000/km has been included for right-of-way clearing. It may well be that such clearing is not required and this amount could be reduced or eliminated altogether.

As noted in Part 4, the costs included in the estimates for the distribution of power throughout the Muskrat Dam community could possibly be reduced depending on what presently is in existence.

The estimated cost for the development of the power facility including distribution to indivdual residents via the use of a submarine cable across Muskrat Dam Lake with a second back-up cable is estimated to cost $2,480,000. The estimated cost for the power facility including distribution via use of an overhead transmission line around Muskrat Dam Lake is estimated to be $2,730,000.

The breakdown of the conceptual cost estimate is shown in Appendix B; all cost estimates are shown in November 1982 Canadian dollars. Due to their preliminary nature, the estimates must be considered budgetary only, at an assumed accurancy -10% to +30%.

6.0 CONCLUSIONS

This study of a proposed hydroelectric development on the Windigo River is of a preliminary nature only. However, the review has indicated that it is technically feasible to develop a power facility at the selected site.

Should this project be considered for development, detailed mapping and surveys of the project area including the transmission line location would be required.

PRELIMINARY FEASIBILITY STUDY

APPENDIX A

DESIGN OF CANALS FOR HYDROELECTRIC PLANTS IN COLD CLIMATES

Design of Canals for Hydroelectric Plants in Cold Climates
(Extract from a Report by Mr. J.K. Sexton)

Life is facilitated in the high latitudes of the earth because water, on changing to its solid phase (as ice), has a lower specific gravity than it has in its liquid phase. In other words, ice floats. A second fortunate circumstance is that ice has a relatively low thermal conductivity. Hence, all our surface waters in these freezing latitudes, whether still or flowing, are provided with a mechanism for covering themselves with an insulating blanket of ice each winter to make possible the attainment of a thermal balance whereby the water below remains in its liquid phase and continues to support life - and also hydroelectric power. In the latter usage, however, there are some simple, but fundamental, requirements to be met. But first it is necessary to describe the various ways in which ice may form.

From an engineering point of view, the formation of ice may be divided into two categories, static and dynamic. Static ice is that which forms as a flat sheet of more or less uniform crystalline structure on still and slow moving bodies of water free of turbulence. Dynamic ice is that which forms within more rapid and turbulent waters as frazil and anchor ice, which increases in concentration with continued low temperature exposure to form dense runs of slush ice. These in turn cause slush ice jams that build progressively upstream, creating winter flooding along the way, and eventually accomplishing nature's purpose of covering enough of the surface of even the most turbulent stream with a thick, rough, blanket of consolidated slush with sufficient insulation value to permit the stream below to flow in a thermal balance for the remainder of the winter.

For trouble free winter operation of hydroelectric plants it is essential to confine the formation of ice on its supply waters to the static variety; and for this purpose it is necessary to establish the approximate boundary between static and dynamic ice formations. From the point of view of pure science that establishment of such a boundary may be a complex matter; but from an engineering point of view we know that if water is flowing in a channel of more or less uniform cross section and gradient with an average velocity of less than 1.5 feet/second it will usually form a trouble-free, static ice cover. Knowledge of this basic fact has made it possible to use canals to develop firm, reliable, hydroelectric power in Canada's far north - as at Whitehorse Rapids and Aishihik. The rules for such canals are relatively simple:

(i) The cross section and the gradient of the canal bottom must be such that at full load and maximum forebay drawdown the velocity of the water flowing in the canal will not exceed 1.5 feet/second.

(ii) The crest of the canal embankment must be level from end to end, i.e. the canal depth increases uniformly in a downstream direction.

(iii) If there is no control structure at the canal entrance, i.e. if the canal takes off directly from a pondage reservoir, there will be no spillway in the canal embankment.

(iv) If there is a control structure at the canal entrance, there may be an emergency spillway provided in the canal embankment usually near the upstream end.

There is one other ice hazard that may occasionally shut down a hydro plant at the end of a canal, regardless of how well the canal design may conform to the rules listed above. The trouble in this case is not due to the canal, but to the small size and shallow depth of the forebay pond; and it can afflict any hydro plant with a small forebay, regardless of whether or not it is fed by a canal. It occasionally happens in the late fall, just before a protective ice cover can form on a small forebay, that there will be sharp drop in air temperature below 0°C accompanied by a strong wind. This can cause waves and spray on the forebay surface and so accelerate the loss of heat to the atmosphere as to supercool the water of the forebay (i.e. its temperature would drop slightly below 0°C with the water still remaining in its liquid phase). This of course, is the condition that leads to the formation of dynamic frazil and anchor ice; and in this case it is the anchor ice that may do the damage. It tends to form on any surface kept at the same supercooled temperature by the action of the velocity or turbulence of the water - and the most likely surfaces are those of the trash racks, where velocities are highest. The result may be the rapid formation of anchor ice on the racks followed by the shut-down of the plant with dramatic suddenness.

This danger can be alleviated by the electric heating of the bars of the trash racks. To do this the bars must be connected in series and insulated from each other, and from their supporting structure, so that an electric current of sufficient amperage can be passed through them to raise their temperature by a minute fraction of a degree. The objective, of course, is not to generate enough heat to melt slush - that would be out of the question - but merely to keep bar temperature just high enough to prevent the formation of anchor ice.

In warmer climates, or in hydro plants in cold climates intended to operate only in summer time, the rules for canal construction listed above can, of course, be relaxed. In this case the common practice is to select the canal section, velocity and gradient for optimum economy, taking care only to keep canal velocities low enough to avoid erosion. Moreover, the crest of the canal embankment can follow the same gradient

as the bottom of the canal down to the level of the forebay embankment, in which case a spillway compatible with full discharge capacity of the canal must be installed at or near the forebay. This is the situation which prevailed at the Klondike North Fork Hydro Plant when it was operating.

PRELIMINARY FEASIBILITY STUDY

APPENDIX B

COST ESTIMATES

MONTREAL ENGINEERING COMPANY LIMITED

ESTIMATE

CUSTOMER: Ontario Ministry of Energy

FILE: OME 7915-0

PROJECT: " Muskrat Dam Hydro Development

DATE: November 1982

ESTIMATED BY: J.K., R.D.P., J.H.D., T.K.H., T.H. CHECKED BY: D.G.M., F.L.L.

TYPE OF ESTIMATE:

(1) PRELIMINARY APPRAISAL TO INDICATE GENERAL MAGNITUDE OF COST:	
(2) PRELIMINARY ESTIMATE BASED ON PARTIAL FIELD INFORMATION:	X
(3) CONSTRUCTION ESTIMATE BASED ON FULL FIELD INFORMATION:	

DESCRIPTION OF PROJECT:

The development of a power facility at Muskrat Dam would consist of installing two 100 kW Mini Hydel Stations at the end of a 60 m long canal cut in rock across a peninsula on the right bank of the Windigo River approximately one kilometer upstream of Muskrat Dam Lake. Transmission would be by either a 15 km long overhead line around Muskrat Dam Lake or by submarine cable across the lake to the Muskrat Dam Community.

AVAILABLE INFORMATION: (INCLUDE REFERENCE TO ADDITIONAL INFORMATION REQUIRED)

Site information including Geologic, Topographic and Hydrologic data was taken from Ontario Hydro report "Severn River Muskrat Dam Community/Windigo River Power Site Feasibility Analysis" dated November 1979. Additional topographic data for the transmission facility was taken from the Department ofEnergy, Mines and Resources 1:50,000 Topographical Survey Maps.

(Overhead transmission alternative, total estimated cost $2,730,000)

APPROVED

CIVIL DEPARTMENT:

ELEC. DEPARTMENT:

MECH. DEPARTMENT:

CONST. DEPARTMENT:

COST

November 1982 Cdn. Dollars

DOLLARS:

_____ LOCAL CURRENCY AT _____: DOLLARS:

Submarine Cable Alternative TOTAL ESTIMATED COST: $2,480,000

MECo 12-C62B (REV 2 77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF Muskrat Dam Hydro Development

FILE OME 79150 **DATE** November 1982 **ESTIMATED BY** T.M. **PAGE** 2 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			SUMMARY - POWER GENERATION			
			Land & Water Rights		-	
			Preliminary Works		60,000	
			Diversion Works & Water Control		50,000	
			Headrace & Headworks		280,000	
			Powerhouse & Tailrace		90,000	
			Turbines & Generators		370,000	
			Miscellaneous Mechanical Equipment		90,000	
			Miscellaneous Electrical Equipment		50,000	
			Standby Diesel Generator		70,000	
			Mobilization, Demobilization & Demurrage		260,000	
			Temporary Facilities		120,000	
			Engineering & Management		120,000	
			Owner's Administration		20,000	
			General Contingency		240,000	
			TOTAL POWER GENERATION COST			1,820,000

MECo. 12-0628 (REV. 2/77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF Muskrat Dam Hydro Development

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** J.H.D., T.K.H. **PAGE** 3 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			SUMMARY - TRANSMISSION & DISTRIBUTION			
			Alternative I - O.H. Transmission/Submarine Cable			
			Switchyard, transmission line, submarine cable, community			
			distribution		510,000	
			Engineering and Management		50,000	
			Owner's Administration		15,000	
			Contingency		85,000	
			TOTAL TRANSMISSION & DISTRIBUTION COST			660,000
			Alternative II - O.H. Transmission Line Only			
			Switchyard, transmission line, community distribution		730,000	
			Engineering and Management		50,000	
			Owner's Administration		15,000	
			Contingency		115,000	
			TOTAL TRANSMISSION & DISTRIBUTION COST			910,000

MECo. 12-0628 (REV. 2 77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF Muskrat Dam Hydro Development

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** T.M. **PAGE** 4 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			LAND & WATER RIGHTS			
			(Not included)			-
			PRELIMINARY WORKS			
	1	L.S.	Winter Roads & Ice Bridges	-	50,000	
	1	Ha	Site Clearing	10,000	10,000	
			SUB TOTAL			60,000
			DIVERSION WORKS & WATER CONTROL			
	500	m^3	Cofferdam Placement	20	10,000	
	500	m^3	Cofferdam Removal	30	15,000	
	200	m^3	Rock Plug Removal	100	20,000	
	1	L.S.	Water Control	-	5,000	
			SUB TOTAL			50,000

MECo. 12-062B (REV. 2-77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF Muskrat Dam Hydro Development

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** J.K., T.M. **PAGE** 5 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN:	
			HEADRACE & HEADWORKS			
	1,800	m^3	Rock Excavation	50	90,000	
	120	m^3	Reinforced Concrete	1,200	144,000	
	1	L.S.	Allowance for miscellaneous items (20%)	-	46,000	
			SUB TOTAL			280,000
			POWERHOUSE & TAILRACE			
	500	m^3	Rock Excavation	50	25,000	
	20	each	Rock Anchors	100	2,000	
	40	m^3	Reinforced Concrete	1,200	48,000	
	1	L.S.	Allowance for miscellaneous items (20%)	-	15,000	
			SUB TOTAL			90,000
			TURBINES & GENERATORS			
	2	each	100 kW Mini Hydel Station incl. - transportation & erection	185,000	370,000	
			SUB TOTAL			370,000

MECo 12-0628 (REV. 2-77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF MUSKRAT DAM HYDRO DEVELOPMENT

FILE OME 7915-0 DATE November 1982 ESTIMATED BY J.K., R.D.P. PAGE 6 OF 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			MISCELLANEOUS MECHANICAL EQUIPMENT			
	2	L.S.	Trashracks (2.6 m x 2.6 m) 800 kg each	-	12,000	
	2	L.S.	Bulkhead Gate (1.8 m x 1.8 m) & Embedded Parts incl. lift	-	30,000	
	1	L.S.	Timber Stoplogs (1.8 m x 1.8 m) & Embedded Parts	-	15,000	
	1	L.S.	Pre-engineered Building		20,000	
			Allowance for miscellaneous items		13,000	
			TOTAL			90,000
			MISCELLANEOUS ELECTRICAL EQUIPMENT			
	1	L.S.	Transformers, cables & conduits, lighting, heating	50,000	50,000	
			and grounding			
			TOTAL			50,000
			STAND-BY DIESEL			
	1	L.S.	120 kW Diesel and step-up Transformer	50,000	50,000	
	10	m^3	Reinforced concrete, base slab	1,000	10,000	
	1	L.S.	Pre-Engineered Building	-	10,000	
			TOTAL			70,000

MECo. 12-0628 (REV. 2 77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF Muskrat Dam Hydro Development

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** T.M. **PAGE** 7 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			MOBILIZATION, DEMOBILIZATION & DEMURRAGE			
	1	L.S.	Equipment Mobilization	-	10,000	
	9	month	Equipment Demurrage	20,000	180,000	
	1	L.S.	Equipment Demobilization	-	10,000	
	1	L.S.	Air Transportation of Personnel & Camp Supplies	-	40,000	
	1	L.S.	Allowance for miscellaneous items (10%)	-	20,000	
			SUB TOTAL			260,000
			TEMPORARY FACILITIES			
	1	L.S.	Construction Camp Erection	-	40,000	
	4	month	Construction Camp Operation	15,000	60,000	
	1	L.S.	Construction Camp Removal	-	10,000	
	1	L.S.	Allowance for miscellaneous items (10%)	-	10,000	
			SUB TOTAL			120,000

MECo. 12-062B (REV. 2/77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF MUSKRAT DAM HYDRO DEVELOPMENT

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** J.K., D.G.M. **PAGE** 8 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN	
			ENGINEERING & MANAGEMENT			
			Site investigation		10,000	
			Preparation of contract drawings & specification		70,000	
			Site supervision		40,000	
			SUB TOTAL			120,000
			OWNER'S ADMINISTRATION		20,000	
			SUB TOTAL			20,000
			GENERAL CONTINGENCY			
			Physical Contingency (15% of $1,580,000)			240,000
			TOTAL POWER GENERATION FACILITIES COST			1,820,000

MECo. 12-0628 (REV. 2/77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF MUSKRAT DAM COMMUNITY - TRANSMISSION AND DISTRIBUTION SYSTEM

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** J.H.D., T.K.H. **PAGE** 9 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN:	
			ALTERNATIVE I - O.H. TRANSMISSION/SUBMARINE CABLE			
			Switchyard	L.S.	60,000	
			Transmission line, 7.0 km incl. clearing, poles,	L.S.	240,000	
			insulators, conductor			
			Submarine cable, 0.8 km incl. trench, cable	L.S.	130,000	
			Community Distribution incl. poles, conductor,	L.S.	80,000	
			transformers, secondary circuits			
			SUB TOTAL		510,000	
			Engineering & Management		50,000	
			Owner's Administration		15,000	
			SUB TOTAL		575,000	
			Contingency @ 15%		85,000	
			TOTAL			660,000

MECo. 12-0628 (REV. 2/77)

MONTREAL ENGINEERING COMPANY, LIMITED

ESTIMATE OF MUSKRAT DAM COMMUNITY - TRANSMISSION AND DISTRIBUTION SYSTEM

FILE OME 7915-0 **DATE** November 1982 **ESTIMATED BY** J.H.D., T.K.H. **PAGE** 10 **OF** 10

ACCOUNT No.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTALS IN:	
			ALTERNATIVE II - O.H. TRANSMISSION LINE ONLY			
			Switchyard	L.S.	60,000	
			Transmission line, 15.0 km incl. clearing, poles,	L.S.	590,000	
			insulators, conductor			
			Community distribution incl. poles, conductor,	L.S.	80,000	
			transformers, secondary circuits			
			SUB TOTAL		730,000	
			Engineering & Management		50,000	
			Owner's Administration		15,000	
			SUB TOTAL		795,000	
			Contingency @ 15%		115,000	
			TOTAL			910,000

TABLE 1-5

Summary of Fur Trapping Data for Muskrat Dam Indian Band

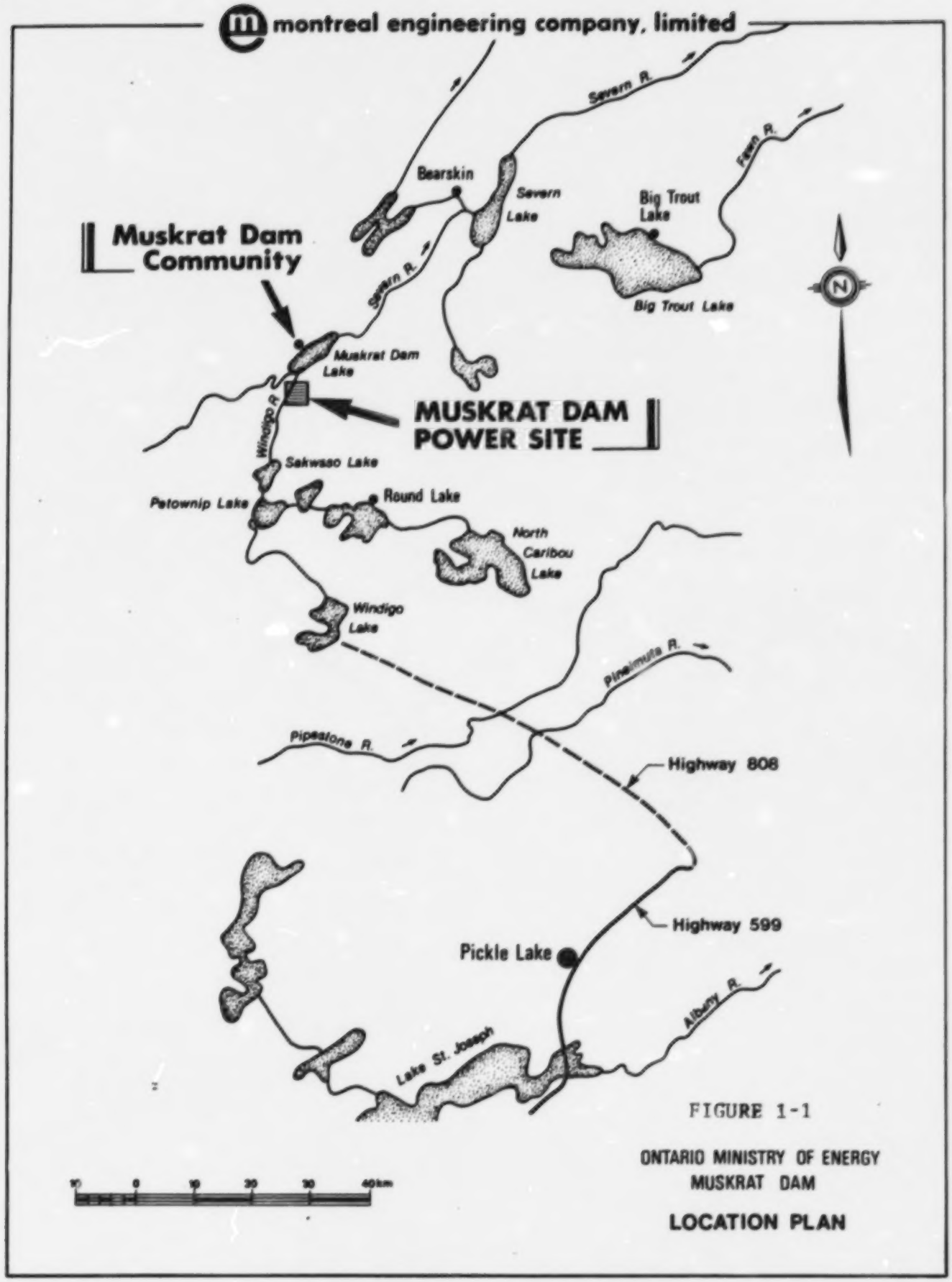
	1981-82			1980-81			1979-80		
	NO. OF PELTS	AVG. PRICE	TOTAL VALUE	NO. OF PELTS	AVG. PRICE	TOTAL VALUE	NO. OF PELTS	AVG. PRICE	TOTAL VALUE
BEAVER	304	22.56	6,858.24	642	34.57	22,193.94	977	47.74	46,641.98
MINK	92	24.50	2,254.00	120	29.66	3,559.20	105	26.50	2,782.50
MARTEN	127	31.72	4,345.64	199	30.61	2,326.36	124	30.87	4,136.58
OTTER	55	48.15	2,648.25	76	61.28	4,657.28	84	68.80	5,779.20
FISHER	20	150.23	3,004.60	17	143.00	2,431.00	24	168.65	4,071.60
LYNX	1	223.37	223.37	2	282.82	565.64	1	214.38	214.38
MUSKRAT	163	487	793.81	722	7.51	5,422.22	1647	8.19	13,488.93
SQUIRREL	-	1.15	-	41	1.44	59.04	26	1.50	39.00
WEASEL	-	.74	-	13	.93	12.09	5	1.82	9.10
COLOURED FOX	4	75.47	301.88	2	85.88	171.76	1	68.92	68.92
TIMBER WOLF	-	83.27	-	2	94.20	188.40	-	72.74	-
WOLVERINE	1	165.95	165.95	1	206.62	206.62	-	166.72	-
YEARLY TOTAL FUR VALUES			$20,595.74			$41,793.55			$77,232.19
NO. OF TRAPPERS			26			25			24

Source: Ontario Ministry of Natural Resources 1982.

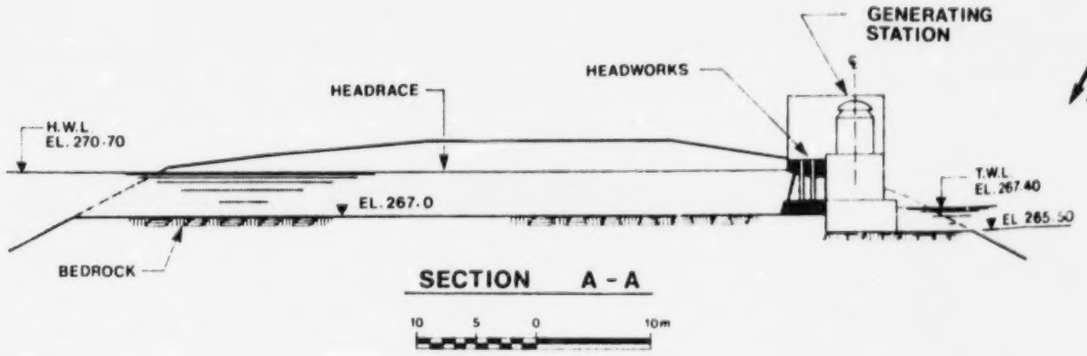
.3 Land Resources

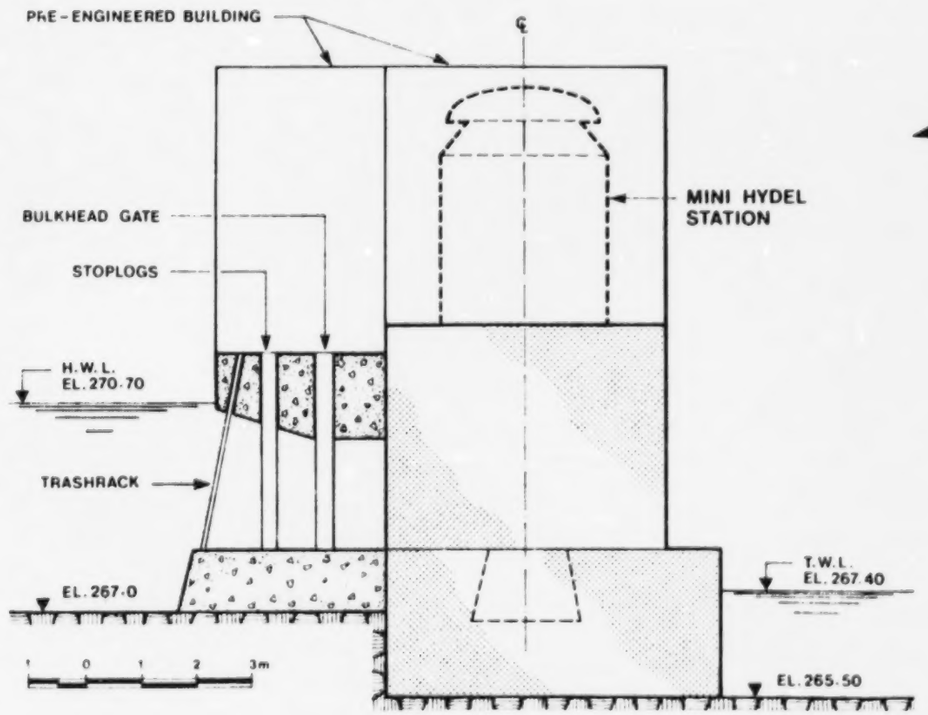
The community is determined to use its natural resources wisely, since their livelihood is very much dependent on them. Future community development will be carefully planned and assessed so as to minimize adverse impacts to these resources.

More detailed discussion on the subject of community planning is available in a recently completed community plan commissioned by the Band Council. However, at the time this report was prepared, a copy of the plan was not available for review. Thus, the preceding discussion should be reviewed as somewhat incomplete.


montreal engineering company, limited
Severn R.
Fawn R.
Bearskin
Severn Lake
Big Trout Lake
Muskrat Dam Community
Severn R.
Big Trout Lake
N
Muskrat Dam Lake
MUSKRAT DAM POWER SITE
Windigo R.
Sakwaso Lake
Petownip Lake
Round Lake
North Caribou Lake
Windigo Lake
Pipestone R.
Pipestone R.
Highway 808
Highway 599
Pickle Lake
Albany R.
Lake St. Joseph
40km
FIGURE 1-1
ONTARIO MINISTRY OF ENERGY
MUSKRAT DAM
LOCATION PLAN

montreal engineering company, limited





INTAKE ARRANGEMENT

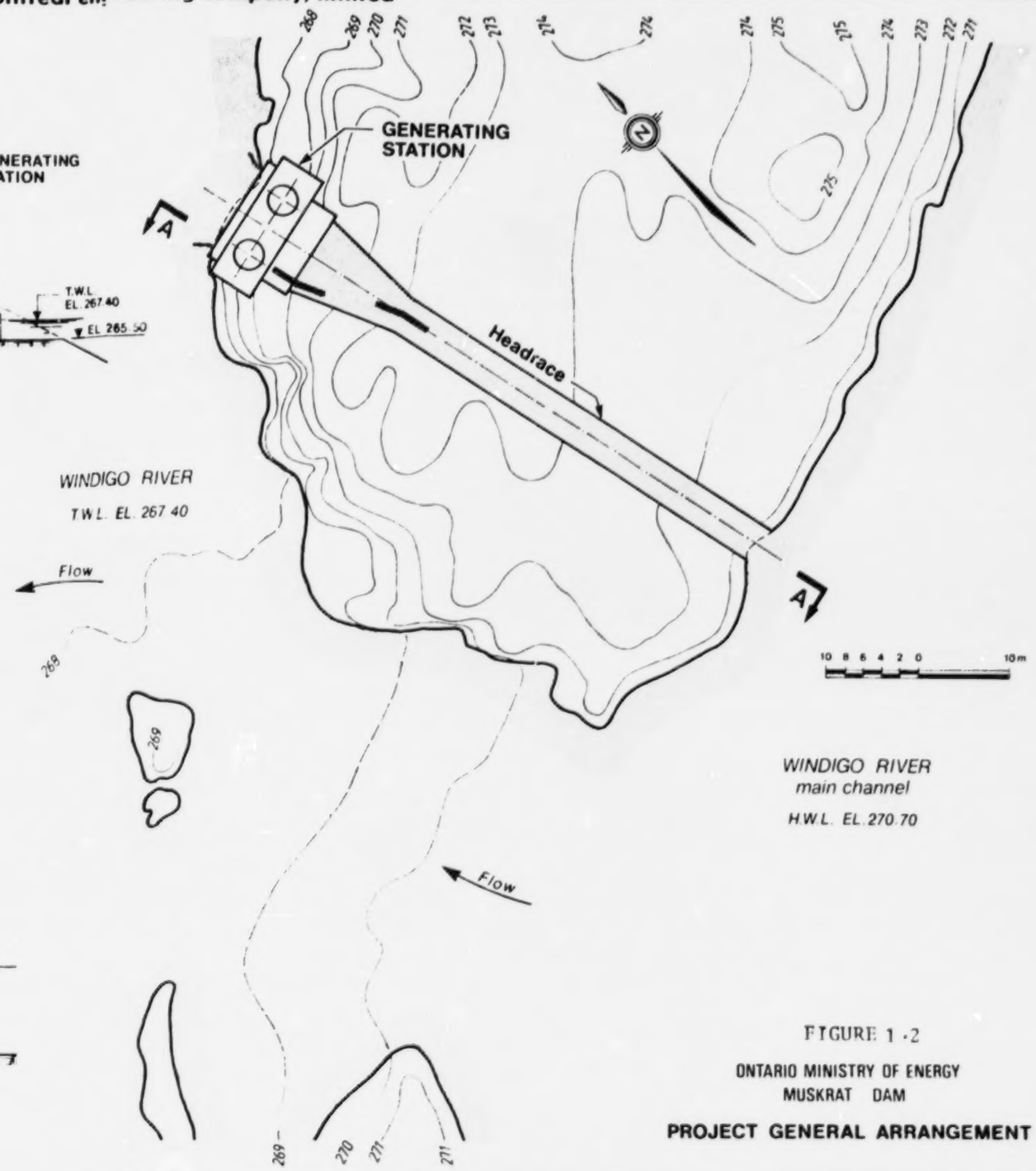
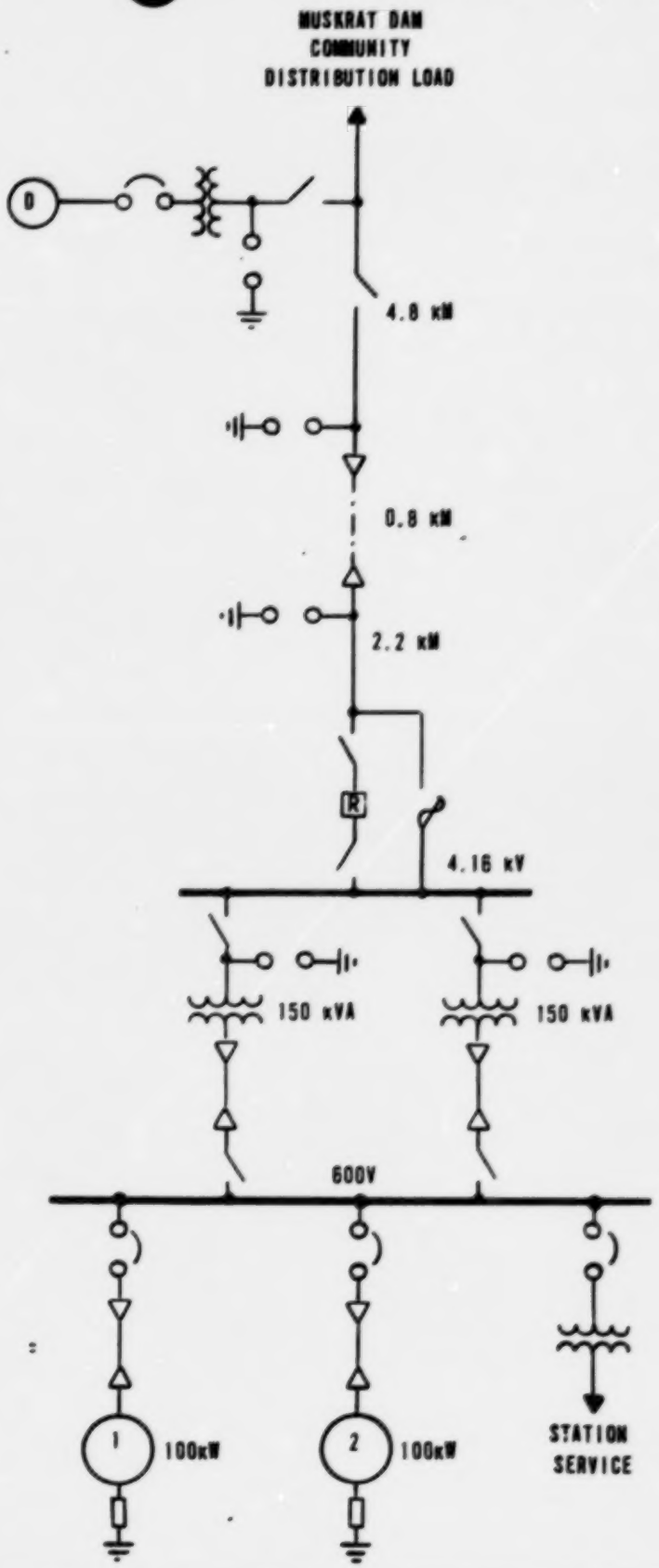


FIGURE 1·2

ONTARIO MINISTRY OF ENERGY
MUSKRAT DAM

PROJECT GENERAL ARRANGEMENT



LEGEND

- GENERATOR
- TRANSFORMER
- RECLOSER
- LV CIRCUIT BREAKER
- LIGHTNING ARRESTERS
- GROUND RESISTOR
- DISCONNECT SWITCH
- CABLE
- SUBMARINE CABLE
- FUSED BY-PASS
- STANDBY DIESEL

FIGURE 1-3

ONTARIO MINISTRY OF ENERGY
MUSKRAT DAM
POWER SUPPLY TO MUSKRAT
DAM COMMUNITY
SINGLE LINE DIAGRAM

ENVIRONMENTAL ASSESSMENT
INTRODUCTION

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1.1 PHYSICAL ENVIRONMENT

1.1.1 LOCATION OF STUDY AREA

Muskrat Dam Lake is located north of 50° north latitude, in the relatively isolated northwest corner of Ontario, about 200 km southwest of Hudson Bay. The lake is a part of the Severn River drainage system (Plates 1-1 and 1-2) which discharges into Hudson Bay. Muskrat Dam Indian Community is located on Muskrat Dam Indian Reserve situated on the northwest side of Muskrat Dam Lake. The Windigo River flows into the south end of Muskrat Dam Lake about two km east of the Severn River. A low head run of river hydro power plant has been proposed for development on the Windigo River approximately one kilometer upstream from Muskrat Dam Lake to provide electricity to the Muskrat Dam Indian Community (Ontario Hydro 1979; Monenco Ontario 1983). At present, accessibility to the Muskrat Dam Lake area is by float plane or by winter road from Pickle Lake located approximately 225 km to the southwest.

1.1.2 CLIMATE

The climate of the region is described as modified continental (Ministry of Natural Resources 1981). The nearest weather station to Muskrat Dam is located at Big Trout Lake, approximately 80 km northeast. The average annual temperature for the area is -3.0°C, with a mean low of -29.5°C in January and a mean high of 2-.9°C in July (Department of Indian and Northern Affairs 1982). Annual precipitation is approximately 38.1 cm as rainfall and about 21.4 cm as snowfall. Violent thunderstorms in the area can generate high winds of between 110 to 150 kilometers per hour; however, the average annual wind speed is 14.8 km/hr (Ministry of Natural Resources 1981).

1.1.3 GEOLOGY AND TOPOGRAPHY

The geological foundation of the study area is the Superior Structural Province of the Canadian Shield (Ministry of Natural Resources 1981). The bedrock comprises metavolcanics and associated metasediments. At the proposed power site the bedrock consists of massive to foliated basalts and andesites. Numerous outcrops of granitic rocks occur to the north and southeast of Muskrat Dam Lake (Ontario Hydro 1979). Occurences of copper, iron and gold have been known to occur in the greenstone belt at the site; however, at present no mining is being conducted in the study area.

Glaciation during the last Ice Age has scoured most the area leaving only a thin mantle of sandy glaciolacustrine sediments over the bedrock. Eskers and morraines also occur in the general area. The resulting topography is hummocky, comprising a general landscape of relatively heavily wooded low hills. Drainage is northward and eastward towards Hudson Bay.

1.2 STUDY OBJECTIVES

1.2.1 BACKGROUND

The Muskrat Dam Lake Indian Community does not at present have a community electricity supply to provide power to individual homes and local industries. Privately owned generators are used to supply power to the school complex, for telephone service and to operate the community sawmill on a periodic basis.

In 1977 Ontario Hydro on the behalf of the Department of Indian and Northern Affairs (DIANA) undertook a reconnaissance study to determine the potential for the development of hydroelectric power to supply the community with electricity from a site on the Windigo River approximatey 6 km to the south. The Ontario Hydro findings were presented in a 1979 report which confirmed good foundation conditions and sufficient head concentration to permit development of a run of river hydroelectric plant. In September 1977 discussions between Ontario Hydro and Council members of the Muskrat Dam Community indicated that the concept of constructing a mini hydroelectric installation for community power was generally acceptable (Ontario Hydro 1979). However, in 1977 the Muskrat Dam community had low priority on the DIANA electrification program; hence no further development action was undertaken until 1982.

In 1982 Monenco was contracted by the Ontario Ministry of Energy to reassess the feasibility of developing hydroelectric power at the Windigo River site. Monenco was to assess the various development alternatives presented in the Ontario Hydro (1979) report and recommend and estimate costs for the most feasible development alternative. In addition, Monenco was to conduct a preliminary environmental assessment to determine the impacts of the proposed hydro development on the Muskrat Dam community and to recommend mitigative measures where necessary.

The hydro development feasibiltiy study conducted by Monenco is presented in a separate report (Monenco Ontario Limited 1983). Essentially the report recommends development of a hydro power facility consisting of two 100 KW Mini Hydel Stations installed at the end of a canal extending across a peninsula on the right bank of the Windigo River about one kilometer upstream of Muskrat Dam Lake. Two power transmission corridor routes were also investigated, one of which requires a submarine cable crossing of Muskrat Dam Lake.

The following report describes the present community status of the Muskrat Dam Indian Band and examines socio-economic and environmental impacts which may result from the proposed hydropower development.

1.2.2 OBJECTIVES

The objectives of the Environmental Assessment are firstly to examine the current Muskrat Dam community status in terms of demography, community economy and infrastructure, employment, resource utilization, energy requirements and future development aspirations. Secondly, the various segments of the community are again examined in relation to impacts (both positive and negative) that may result from the proposed power development. Finally, recommendations for mitigative actions are presented to lessen adverse impacts on the community and to increase community participation throughout the duration of the proposed development.

This Environmental Assessment must be considered as preliminary since budgetary restrictions precluded site visits and direct meeting with the affected community. Information presented herein was obtained from published and unpublished government reports and maps and through telephone interviews with individuals familiar with the study area. Discussions were held with staff members from the Ontario Ministry of Energy, Ontario Ministry of Northern Affairs, Ontario Ministry of Citizenship and Culture, Ontario Ministry of Natural Resources, Ontario Ministry of Environment, and the Federal Department of Indian and Northern Affairs. A telephone interview was also conducted with Mr. Stan Beardy, Chief, Muskrat Dam Indian Band. In essence, very little site specific data exists for the study are and conclusions pertaining to anticipated impacts are based largely upon Monenco's experience in other areas where Canada's native peoples were the affected population.

1.3 PRE-DEVELOPMENT COMMUNITY STATUS

1.3.1 HISTORY AND DEMOGRAPHY

The Muskrat Dam Community was originally part of the Big Trout Lake Indians who relocated to the present site when they acquired reserve status for the Muskrat Dam Lake land in 1976 (Davids, personal communication 1982). The Indians of the Muskrat Dam Lake are Cree and Ojibway speaking peoples. Their ancestors, the Selkirk and the Blackduck peoples, inhabited the area 1,000 years ago (Ontario Ministry of Natural Resources 1981). The traditional land-based activities of resource gathering, hunting and fishing are still practised in the Community today.

In 1982 the community had an Indian population of 186, of which 144 were on-reserve and 42 were off-reserve (Davids, personal communication 1982). The off-reserve Indians are largely school-age children attending high schools in the southern centres. It is estimated that 44 children are attending primary school (kindergarten to Grade 8) on-reserve population is non-school age children and senior citizens (over 65 years of age), it is estimated that the working-age population comprises 75 people. Assuming male and female populations are equal, this means that a total of 37 males are of working age. DIANA estimates that there are currently 37 families in the community, which suggests that, on the average, each family has one working-age male.

The community has a non-native population of six or seven people which comprise the families of two primary school teachers. (Davids, personal communication 1982). Muskrat Dam is a rapidly growing community. Its population has increased from 123 people in 1978 (Ontario Hydro 1979) to 172 people in 1980 and to 186 people in 1982 (Department of Indian and Northern Affairs 1982). It is considerd that between 1978 and 1980 the substantial population increase was largely due to in-migration. Between 1980 and 1982, the growth rate of 4% per year was mainly due to natural growth (Davids, personal communication 1982). It is believed that this growth rate will gradually decrease, and by the year 2000, the community is predicted to have a population of 292 people (Department of Indian and Northern Affairs 1982).

The demographic structure of the community suggests that the child population (age 1-15 years) is slightly larger than the adult population. A family size of five persons per family appears to be the norm. The growing child population will become a growing young adult population in the very near future increasing the demand for employment and the use of the surrounding natural resources. The requirements of this increasing young adult population are considered to be important factors in any form of planning for the community.

1.3.2 COMMUNITY ECONOMY

Muskrat Dam is an isolated community in the Sioux Lookout region of Northern Ontario. The regional centre, Sioux Lookout, is 370 km away. The only access to Muskrat Dam is by float plane. The community has no economic ties with Sioux Lookout, although most government services are administered from the regional centre.

Muskrat Dam imports its food and other supplies mainly from Pickle Lake, a distance of 420 km, and from Winnipeg, 470 km away (Plate 1-2). The community exports its fur and fish through North Bay and Transcona/Winnipeg respectively.
Lumber is also a minor export commodity which is sent mainly to the adjacent regional communities (Beardy, personal communication 1982).

The labour economy of the community is a mix of wage employment and traditional resource harvesting. Table 1-1 summarizes the employment profile of the community during 1980.

In the primary sector, the seasonal employment of trapping and fishing represent the participation of the committed workers only. Inclusion of part-time fishermen and trappers would increase the participation rate. For instance, Table 1-1 suggests that there were only 16 serious trappers, but available data on trappers' income (Table 1-5) shows that a total of 24 people participated in trapping in 1980. Thus, about eight trappers can be considered as part-time or less serious trappers. It is expected that the fishing sector has a similar pattern of labour participation. The commercial fishermen also work in the fish packing plant in the community on a seasonal basis.

The secondary sector comprises saw-milling, seasonal construction and transportation. The sawmill utilizes logs from the adjacent forest, and in addition to supplying local needs for housing construction and heating fuel, some lumber is exported to other communities in the region (Beardy, personal communication 1982). The sawmill employed about 12 people of which five were on a part-time basis. The sawmill is presently being operated eight months each year. Construction employment is probably largely related to housing and institution buildings. About 13 people were employed in this sector in the summer of 1980. Transportation consists of a float-plane operation and a winter-road trucking operation managed by Windigo Transportation. Transportation is also a seasonal operation which employed four people during 1980.

The tertiary sector consists of a coffee shop and two general stores. This sector employed a total of three people during 1980.

The public sector had a total of 10 employees in 1980; seven with the Band Council and three with the Federal Government.

Most people with seasonal employment in the primary and the secondary sectors probably participate in two or more of the local industries since many seasonal jobs do not overlap in labour requirements. For example, a person who fisnes and works in the fish ice house in the summer can still have full participation in trapping during the winter and also hold a temporary job with the transportation company.

Overall during 1980 the community provided 13 full-time jobs and 52 seasonal jobs. This pattern is likely the same today with perhaps a few jobs added. If one seasonal job is assumed to be equivalent to a third of a full-time job, then a total of 31 people were employed year-round. With an estimated local male labour force of 34, this represents a 90 per cent employment rate. An interview with the Band Chief confirmed that this situation is still true in 1982. However, it is the aspiration of the community to see improved and more varied economic opportunities in the future, particularly for the growing young population. Community perceptions of future development considerations are discussed in Section 137.

TABLE 1-1

Employment Profile of Muskrat Dam, 1980

Primary Sector	Natives Employed
Fishing (seasonal)	12
Trapping (seasonal)	16
Secondary Sector	
Manufacturing-Sawmill (seasonal)	7
Construction (seasonal)	13
Transportation (seasonal)	4
Tertiary Sector	
Retail	3
Public Sector	
Band Government	7
Federal Government	3

Source: Department of Indian and Northern Affairs 1982.

Because of the relatively high level of employment in the community, welfare income is not considered to be a major source of income for community families. Rather, it is probably received as a supplementary income for most families (Davids, personal communication 1982).

At least as important a livelihood in the community for most families is the participation in traditional hunting, fishing and gathering activities to provide food supplies (Beardy, personal communication 1982). The diet of most native families is supplemented by commercially-bought food consisting mainly of vegetables and milk products; however, because such food is generally very expensive, only the minimum required quantities are purchased. Country food remains the staple diet. Wood is harvested for individual family use either for space heating or for house construction. Thus, in spite of the high level of wage employment, traditional activities are still a very important aspect of the community's livelihood. On the basis of the review of the community's economy, it can reasonably be concluded that the community, including the female population, is at full working capacity even though a significant portion of the work effort is not regarded with wage incomes. The data suggests that the community's economic quality of life is a balanced mixture of both traditional and modern livelihoods.

1.3.3 HOUSING AND COMMUNITY INFRASTRUCTURE

In 1978, the total number of housing units in the community was 33. With a 1978 population of 123 people, the average occupancy rate was 3.7 persons per house. It is estimated that currently in 1982 there are 40 houses (Davids, personal communication 1982). With a 1982 on-reserve population of 144 people, the average occupancy rate is presently 3.6 persons per house. It is the intention of the community to build four houses a year in the foreseeable future.

Table 1-2 summarizes the current level of community facilities and services. Overall, the facilities and services are minimal. Transportation to outside communities is expensive and services are limited. An interview with the Department of Remote Airport Development (Ontario Ministry of Northern Affairs) indicates that a plan to build an airport for the community has been contemplated. However, actual construction is unlikely to occur in the next two years. If an airport were constructed, the power requirement for its operation is estimated at 75 to 100 KW (Gracen, personal communication 1982).

Communication services consist of a toll telephone station and a local station.

TABLE 1-2

Muskrat Dam - Community Facilities and Services

Transportation

- No land-based air facilities, only float and ski equipped aircraft
- Service offered by Austin Airways (Class 3 service), Bearksin Air and Aerotrades
- Tariffs (1982): Passenger, Pickle Lake - Muskrat Dam, one way, $68.
  Freight, Pickle Lake - Muskrat Dam, 67¢ per pound
- Winter Road to Round Lake, trucking service offered by Windigo Transportation operated by Muskrat Dam Band.

Communications

- Bell Canada, one radio telephone
- Local radio, repeated service - CBC

Local Transportation

- No private vehicles
- Band owned - 2 bulldozers and a farm tractor

Commercial Facilities

- General store, Beardy's Store, coffee shop
- Overnight cabin facilities for one or two people

Industrial Facilities

- Ice house for fish packing 1 km from centre of town, no refrigeration facilities
- Sawmill, capacity unknown

Institutional Facilities and Services

- Church - Anglican
- 2 schools - 205 m^2, teacherage - 62 m^2, associated buildings - diesel house of 18 m^2 and pumphouse of 7 m^2
- Health clinic, periodic visit from Round Lake Nursing Station (nearest hospital in Sioux Lookout)
- No recreation facilities
- Some equipment for fire protection
- Police - OPP, Northwest Air Patrol
- Band office

Municipal Services

- No sewage or power facilities

Source: Department of Indian and Northern Affairs 1982

The Band owns two bulldozers and a farm tractor. There are no privately owned v hicles.

Commercial facilities, including two general stores and a coffee shop, serve only local needs. There are no facilities to accommodate tourists or visitors on a commercial basis. Overnight cabin facilities are available; however, only one or two persons can be accommodated at a time.

Both the fish packing house and the sawmill, the only industrial facilities in town, are limited in capacity by inadequate energy supply. There is no refrigeration facility for the fish packing operation which utilizes ice cut from the lake during wi:ter. The sawmill is operated with limited diesel generated power.

Institutional facilities and services consist of an Anglican Church, two schools (kindergarten to Grade 8), a nursing clinic with periodic nurse visits and a Band office. There are no recreational facilities and no fire hall or police station, although some equipment is available for fire protection and the community receives police air patrol service.

1.3.4 COMMUNITY ENERGY USE

Muskrat Dam currently has no community electrical generating facilities. The schools and ell Canada operate their own diesel electric generating facilities.

Wood is used for space heating in all native households. Annual wood consumption is estimated at 10 cords per household (Department of Indian and Northern Affairs 1982).

Fuel oil is also used for institutional space heating and institutional electrical generation. It is expected that propane and kerosene are used for cooking and lighting in native homes. However, only a volume estimate for the quantity of propane used in institutional facilities (3,637 L) in 1981 is available. Fuel sources for the fish packing house and the sawmil are not known but ar probably diesel. Information on other fuel sources and their uses is not available.

The Department of Indian and Northern Affairs (1982) estimated that in 1980, the community consumed 9,600 GJ of energy in total. This estimate, however, is based on incomplete information, particularly for native homes (except for heating) and for local industrial uses. Table 1-3 provides a summary of fuel uses. It is apparent that wood presently constitutes the largest energy source in the community.

TABLE 1-3

Muskrat Dam - Estimated Community Energy Consumption, 1980

	GJ
Fuel Oil	
Space Heating	1379
Electrical Generation	2081
Gasoline	N/A
Aviation	-
Propane	93
Wood	6086
Other	N/A
TOTAL	9546

Source: Department of Indian and Northern Affairs 1982

1.3.5 HERITAGE RESOURCES

There are four known archaeological sites within 60 km of Muskrat Dam on the Severn River. Three are upstream and one is downstream from the proposed hydro site (Plate 1-1). These suggest that the landscape of the project area has high archaeological potential (Conway, personal communication 1982).

1.3.6 RESOURCE UTILIZATION

.1 Fishing

The Muskrat Dam Band relies on commercial and subsistence fishing to provide a portion of their yearly income and food for the Band. Four lakes have been allocated to the Band for commercial fish harvesting: Muskrat Dam, Knife, Two Rivers and Asipoquobah. Commercial fish production for Muskrat Dam Lake for the years 1979, 1980 and 1981 is provided in Table 1-4. Muskrat Dam Lake and the other three lakes are fished on a rotational basis to prevent over harvesting. No commercial fishing occurred in Muskrat Dam Lake in 1980.

Three fish species of commercial importance occur in Muskrat Dam Lake: lake whitefish, walleye, and northern pike. Lake whitefish are caught in the greatest numbers, followed by walleye. Northern pike are not captured in sufficient numbers to justify processing at a commercial level and are probably utilized locally.

Other fish occurring in the lake include: sturgeon (Aceipenser sp.), suckers (Catostomus spp.) and minnows (Cyprinid spp.). Members of the Band also fish for sturgeon in the Windigo River upstream of the proposed mini-hydro development (J. McDonald, personal communication 1982).

About 12 members of the Muskrat Dam Band participate in commercial fishing with most of the fishing effort expended at the south end of the lake. The commercial fishing season normally lasts from July to September which corresponds to the ice free period. In winter, subsistence fishing through he ice also occurs. No sport fishing occurs on the lake; however, the band would like to develop a fly-in sport fishery at some time in the future (Beard , personal communication 1982). No sport fish guiding is presently being done by the Band.

.2 Trapping

The availability of commercial quantities of fine furs, particularly beaver, drew the first European traders to this area over two centuries ago. Fur trapping has been and remains an important source of income to the native people. The Muskrat Dam Lake Band trapping area, part of the Sandy Lake Management Area, was harvested by 25

TABLE 1-4

Commercial Fish Production - Muskrat Dam Lake

Species	Scientific Name	Year 1979 (kg)	1980 (kg)	1981 (kg)
Lake Whitefish	Coregonous clupeaformis	8115	-	4597
Walleye	Stizostedion vit. vit.	1245	-	2450
Northern Pike	Esox lucius	-	-	-

Source: Ontario Ministry of Natural Resources 1982.

to 27 individuals during the period 1979-80 to 1981-82 according to Ontario Ministry of Natural Resources (MNR 1982). Generally it was estimated by the MNR that, in common with other remote areas, the fur harvest realized about 50 per cent of its potential, thus room exists for substantial increases. Data available for the three seasons of 1979-80, 1980-81 and 1981-82 shows that the most commonly taken species were muskrat, beaver, marten, mink and otter. Table 1-5 shows the number of pelts of each species taken during the last three seasons, the average price paid, their respective values and the number of trappers participating in the harvest. The data suggests, in contrast to MNR estimates, that the fur quantities taken during the 1979-1982 period have decreased annually although the number of trappers has remained almost constant.

Data were not available detailing the income of each trapper. Since it is estimated that there are 37 family units in the village, about two-thirds of the families likely derive some income from fur trapping.

.3 Hunting

Quantitative data on wildlife harvests are not available. However, it is known that just about all families in the community obtain most of their meat by fishing and hunting. There is no recreational or guided hunting.

1.3.7 SOCIAL CONDITIONS AND COMMUNITY ASPIRATIONS

In spite of its isolation and the lack of many modern conveniences, the community of Muskrat Dam is determined to improve its living standards and economic opportunities. The maintenance of a high level of wage-earning employment and the community participation in traditional activities indicate a society with highly motivated community aspirations. In addition, there are no alcohol related problems in the community.

Based on a casual telephone interview with the Band Chief, Mr. S. Beardy, it is observed that a number of areas could be improved mainly as a result of electrification and improved access to the community.

.1 Economic Opportunities

Existing industries, fishery and forestry, can be further expanded. These operations are presently constrained by limited available energy. Potential also exists for the development of new commercial enterprises in guiding (hunting and fishing) and in wild rice harvesting.

.2 Community Services

The community takes pride in improving their housing and standard of living. In conjunction with upgrading individual houses, the community is planning to acquire a number of standard municipal services which are not presently available. These include sewage treatment, electricity, and telephone. There is currently no recreation centre for the community, and no full-time nurses stationed in the community.

Many economic potentials cannot be realized without electrification and the assistance of an adequate transportation system. An airport for the community will definitely improve the economic linkages with the southern economic centres and adjacent potential export markets.

2.1 IMPACTS ON EMPLOYMENT AND INCOME

2.1.1 CONSTRUCTION PHASE

Construction of the proposed mini-hydro project will require both a local and an outside labour force.

On-site manpower will be required for the construction of the mini-hydel power station at the confluence of the Windigo River and the Severn River and for construction of the transmission line from the power station to the community.

The proposed mini-hydel power station will consist of a headrace canal extending across a peninsula east of and above the rapids and a concrete headworks integrated with two 100 kW mini-hydel power units below the rapids. The project is a run-of-river scheme involving no control dam. Two alternative transmission corridors are proposed. Alternative I would involve a 10 to 15 metre wide corridor extending 7.4 km from the power site to the community (Plate 2-1). A submarine cable of approximately 600 m would be required under the Muskrat Dam Lake. Alternative II would involve no underwater cable, but the corridor would be extended from 7.4 km, to 11.4 km, using overhead crossings over the rivers (Plate 2-2).

Preliminary estimates of on-site manpower requirements for construction of both the power station and the transmission line suggest that a non-skilled labour force of approximately 30 people would be required during the peak of the construction period. This labour group would be associated with general civil works including excavation, concrete works, forest clearing and other ancillary functions. The major construction work would occur over a three-month period during summer, although the time required from site mobilization to demobilization would be over about a six month period. Equipment and material for construction would be hauled in by winter road during the winter prior to construction and stored outdoors until construction commences in the summer.

In addition to the non-skilled manpower requirements, the project requires a further 20 or more persons on-site in the skilled category, including engineers, equipment operators, supervisors and drivers, during the peak construction period.

The local native labour force has been estimated at 75 people (male and female) in Section 131. It has been further established that the local labour force is at full working capacity for most of the year if traditional harvesting activities required to maintain community food and shelter requirements are included. Even if only wage employment is considered, fully 90 per cent of the male

labour force is employed in the community of Muskrat Dam. The requirements of a construction work force of 30 non-skilled workers will definitely exceed the capacity of the local labour supply. Many of the native workers would probably leave their present employment for the higher-paying construction jobs. Although the construction period would only last for three to six months, it is highly probable that a large proportion of all the present full-time summer jobs may be displaced, due to job-shifting. It is conceivable that some of the present summer jobs held by the male work force would be "filtered down" to the female work force thereby lessening the job displacement effect. However, to what extent this would take place and whether a significant job loss and disruption of the traditional activities will occur are difficult to predict. The fishery sector appears to be the most vulnerable.

Construction activities may impact the Band's fishing economy if employment opportunities present themselves at the mini-hydro development and individuals, who normally derive income from fishing, accept temporary labour positions at the hydro plant. The construction schedule will conflict with the traditional commercial fishing season that occurs during the open water months of the year. If it is assumed a greater income could be earned from working on the hydro site than from fishing, then Band members may be attracted to any available job opportunities. Conversely, Band members may continue to show a preference for fishing and not involve themselves directly in the hydro project.

An overall positive impact cold be obtained from the construction activities, by reducing the commercial fishing effort for the duration of the project (approximately one commercial fishing season). Fish populations in the lakes usually harvested would benefit from reduced fishing pressure which could result in higher fish yields (assuming environmental considerations remain constant) in the fishing season following the termination of construction activity. This would be consistent with the Band's present policy of rotating commercial fishing over four lakes to prevent over-fishing of available fish stock. Another scenario could result in some commercial fishermen working full time on the hydro project and still continue to fish on a part-time basis.

Since construction will take place during summer months, there should be no competition for winter labour which could result in trappers opting for construction jobs and abandoning their traplines.

The scope of the present study does not allow further examination of the job displacement impact. However, due to the sensitive nature of this potential impact on the community's economy and traditional food-gathering activities, community discussion of this aspect of the construction phase is warranted.

Even if a high level of local labour participation does occur in the hydro project construction, a relatively large in-migrant labour force would still be required. It is anticipated that as many as 20 or more skilled and supervisory personnel required during the peak construction period would have to be recruited from the southern centres, as the skills of the local labour force are likely inadequate to meet these skill requirements.

The income benefit to the local economy is difficult to estimate. There are three potential sources of income; net wages from project employment; expenditures made by the construction company on purchasing local materials or on local rentals; and expenditures of local workers as well as in-migrant workers on local services and consumer goods, which in turn become wages to those workers employed in the service sector. The magnitude of these expenditures are not known at this stage. However, given the relatively undeveloped structure of the local economy, it is reasonable to assume that income from the latter two sources is likely to be minimal. Almost all the equipment and material required for constructing the hydro project will have to be transported from the south. Potential local opportunities include the supply of wood poles for the transmission line and contracting of equipment hauling to the native owned Windigo Transport. Increased expenditures made by local people on consumer goods and services of the community may generate some short-term jobs in the service sector which would be primarily store clerk positions. In-migrant workers will be housed in a self-sufficient construction camp near the construction site. Therefore, camp residents are not expected to spend their wages on local consumer goods and services.

It is considered that wages earned by the local labour force directly from the construction of the hydro project will be higher than income obtained from the existing employment. Nevertheless, the increased income will be of short duration, and it is not known to what extent the existing jobs would be displaced. The net wage income benefit to the community as a whole is the total wages earned from hydro construction minus wages lost to job

displacement. Until precise information on job clarification, duration, wage rates and the extent of job displacement is known, any quantitative prediction on the income benefit to the community at this stage would be highly speculative. However, for the purpose of indicating the order of magnitude of the income effects of the proposed hydro project, it is estimated that between two to three million dollars (1982 value) would be spent on all aspects of the construction works (Monenco Ontario Limited 1983). If 40 per cent of this expenditure is for wages, and assuming that one-tenth of the total payroll is for local wages, it is estimated that between $80,000 to $120,000 would constitute the direct local income from the proposed hydro project. These estimates are preliminary, and require verification.

2.1.2 OPERATION PHASE

A local individual would be contacted for the operation and daily maintenance of the power station once the project becomes operational. Bi-monthly inspections and yearly overhauls would be undertaken by Ontario Hydro personnel.

The station is to be self-regulatory for load fluctuations. The required part-time operator would be paid by contract, the value of which is estimated to be $13,500 per year (1982 value). An operator from the local community would likely require some training. The contractor is expected to pay any casual labour required for assistance, such as handling stoplogs and in operating the plant.

No secondary or indirect employment and income benefit is expected to result from the small contract work relating to plant operation and maintenance.

No impacts on commercial fishing during the operation phase are anticipated, unless some commercial fishermen are hired in a full or part-time maintenance capacity at the plant. In that situation the Band would probably derive less income from fishing unless participation in the commercial fishery is maintained at its present level by other members of the Band. However, even if a commercial fisherman is hired away for the hydro project, the new job created would likely generate higher income than the fisherman's job, thereby rendering a net benefit to the local economy in monetary terms.

Similarly, there is a potential for some trappers to be attracted to the regular income available from operating the new power generation facilities. This would provide substitute income for the individual and it is highly

probable that another band member would take over the trap line left vacant. In any event, trapping harvest is presently estimated at about 50 per cent of potential so there is abundant opportunity for new trappers. The power development as proposed will not reduce the potential for expansion of fur harvesting.

2.1.3 CONCLUSIONS

It is estimated that the project will require about 30 unskilled labourers and 20 or more skilled labourers during the construction phase. The unskilled labourers can be drawn from the community labour force, but probably not without temporary disruption of local industries such as the fishery and sawmill operations. Temporary disruption of traditional activities may also occur. Employment of local individuals during the construction phase is expected to increase individual incomes for a short period of time. It is not possible to predict within the constraints of the available information the total income benefit to the community from the construction phase.

It is expected that operation of the power plan will provide only one full time/part time job for a local individual. Temporary part-time work may also be available at various times for assistance with plant maintenance and brush clearing along transmission lines.

2.2 IMPACT ON COMMUNITY INFRASTRUCTURE

2.2.1 CONSTRUCTION PHASE

During the construction phase of the hydro project, local housing and other construction activities could be affected. The existing available labour force in the local construction sector would likely be attracted to the hydro construction jobs. As a result, local housing and public works projects may be delayed by a summer.

It is anticipated that the in-migrant labour force would be housed in a self-contained construction camp. Therefore, they would not impose housing and other service requirements on the local community. Thus, expansion of local infrastructure to accommodate the in-migrants is not necessary. However during set up of the construction camp, the community may be required to accommodate the supervisory personnel, assuming local natives would be employed to construct the camp. The existing one-to-two person overnight cabin facility is not adequate for this purpose. It is therefore foreseeable that an additional lodging facility would be required. Associated with this

requirement is some demand on consumer goods such as food and daily essentials. The local stores may realize some increase in business. However, due to the short term nature of this demand, no new business establishments are anticipated.

The movement of people, equipment and material would necessitate establishment of appropriate transportation facilities. Although it was stated earlier that most equipment and material would be transported by winter road, movement of manpower to and from the project area may necessitate early construction of an airport. Further examination of the logistics and the air capacity of the existing float plane operation is recommended.

2.2.2 OPERATION PHASE

The impact of the hydro project on the community infrastructure during its operation phase is expected to be beneficial. The reason is mainly that electricity would be made available to the individual houses for the first time in the community.

Although the total generating capacity from the two-unit power station would only be 200 kW, it is expected that this would be more than the estimated peak load requirements as suggested in the 1979 Ontario Hydro study. The following is an extract from the Ontario Hydro (1979) report on the energy requirement forecast:

User	Peak Load (KW)
Houses (40)	80
Teacherage (2)	10
School	5
Church	2
Nursing Station	5
Band Office	2
Coffee Shop	5
Bell Canada	5
Total	114

The excess electrical capacity could be used for future new houses, telephone installation, or new community facilities such as a recreation centre, a health centre, and a fire hall.

It is also the aspiration of the community to see improvement and expansion in the fish packing and sawmill facilities. Whether the potential hydroelectric capacity can accommodate the requirements of these facilities is not known. In order to determine the energy requirements

of the facilities, it is necessary to ascertain the levels of output and the kind of operations desired by the community. It is known that the proposed power plant will be adaptable for expansion, if the energy requirements of the community increase in the future.

Furthermore, the community will likely have an airport sometime in the future. Preliminary forecast of its energy requirement is 75-100KW (Section 133).

Given the above scenario, it may be more cost-effective to consider these future energy needs in the present planning of the hydro power project to allow for a phased expansion as demand and economics warrant. The information required for estimating and planning future energy requirements should be obtained through consultation with the community.

2.2.3 CONCLUSIONS

It is expected that the employment of local individuals during the construction phase will temporarily interfere with local housing and community works projects.

Improvement or expansion of lodging facilities in the community may be required to provide accommodation for in-migrant supervisory personnel during set-up of the construction camp. The in-migrant labour force required during project construction will be housed in the construction camp, which will be self-sufficient. Hence, it is anticipated that increased demand on local housing and consumer facilities will be minimal, although a minor increase in store business may be realized.

The movement of personnel to the construction site requires examination of the logistics and capacity of the present float plant operations in the area. Construction of the proposed hydro project may necessitate early development of a land based airport at the community.

The operation of the power plant will have a beneficial impact on the community through the provision of electricity to individual homes. It is expected that the excess capacity from the proposed project will be used for new homes and general community facilities. The community has also expressed a desire for improvement in local industrial operations such as the sawmill and fish packing facilities. The community should be consulted regarding the disposition of excess energy and future energy requirements to maintain compatibility with the community's growth aspirations.

2.3 SOCIAL IMPACTS

2.3.1 CONSTRUCTION PHASE

The size of the in-migrant labour force required during the peak construction period is probably the most significant direct social impact on the community. It is assumed that a construction camp would be built to accommodate the 20 in-migrants. However, no consideration has been given at this stage with respect to the location of the camp or the kind of bush camp it will be. This facility, depending on its location, its operation policies and the characteristics of the in-migrant workers, could impose a number of social consequences on the existing native community.

.1 Community Interaction

Given the short term nature of the construction period, 3 to 6 months, it is expected that the in-migrant workers are unlikely to be accompanied by their families and it is reasonable to assume that almost all workers are men. Depending on the location of the camp and whether workers are allowed to visit the native community, tension could arise between the single male in-migrant workers and the family-oriented native community which has been fairly isolated from the outside society thus far. The presence of 20 or more new people in or adjacent to the existing community is a very significant presence. Experience suggests that the more isolated and traditional a culture is, the more sensitive it is to the impact of an imposed alien culture. The negative consequence of this confrontation could be alienation among the native people and their families. Such community breakdown, if no action is taken, could lead to alcoholism, crime, family negligence, and the like. Isolation of the construction camp and prohibition of the workers from visiting the community are mitigating measures that should be considered.

Due to the short stay of the in-migrant work force, it is unlikely that the positive effects of co-operation and improved knowledge (of one another's cultural values) would result. Such positive interactions are usually the result of vigorous and conscious efforts by both parties, and longer time is required for the development of this type of interaction.

.2 Employment Related Impacts

As mentioned earlier, due to the high magnitude of the labour requirement for the hydro project relative to that of the indigenous work force, many local workers would be drawn to the short-term high-paying construction jobs from their present employment. Some local jobs would be lost at least for a season (during the summer). The consequence of this is not clear. It is expected that the total net employment and income to the community would be higher than the present level as a result of the hydro project for at least one summer. The short-term nature of this project ensures that no existing jobs would be lost permanently, as local workers can re-assume their regular jobs once the construction terminates. However, such mass mobilization of the work force for a short period of time in a relatively slow-paced community could result in the classic "boom-bust" phenomena. Experience suggests that some individuals could be affected by post-project depression as the high level of activity and income comes to an abrupt termination.

Furthermore, although many local people who want to work on the project would likely be employed, they are almost certain to be employed only for low-skilled or non-skilled jobs. The skilled positions will most likely be delegated to in-migrants. Depending on the hiring policies of the construction company, job discrimination and unfair competition may or may not result.

The above potential negative impacts can be prevented with careful pre-construction planning, direct involvement of the native community in the recruitment process, pre-construction and post-construction employment and family counselling, and responsible monitoring throughout the project construction phase.

.3 Local Inflation

The increase in the income levels of the local project workers could lead to higher demand for consumer goods. Situations often exist where supply cannot keep pace with demand, resulting in short-term shortages. This, in turn, leads to local inflation. The disadvantaged group who are not employed on the project and are on fixed income will be those who are adversely affected by the local inflation.

Preventing the in-migrant workers from visiting the community for consumer goods and services is perhaps the most significant remedy. Among the residents of the community, pooling their resources to assist the less advantaged would lessen the hardship on this group. While resource sharing is probably the current habit, the project might disrupt the process. That is, sharing of fish might be easier than sharing wage monies.

.4 Impact on the Natural Resources

It has been established that the environment and the natural resources are regarded as very important by the people of the community. Harvesting of the renewable resources is their traditional livelihood. This, the people would be particularly concerned about the site location of the construction camp, the power station itself and the transmission corridor. Wastes from the construction camp and the construction activities could pollute soils and the water in sensitive wildlife and fish habitats. A camp waste management plan must be established before camp habitation, and strict adherence to the plan should be assured throughout this phase. Particular attention should be focused on the final clean up before abandonment of the camp.

The influx of in-migrant workers to the area also poses the danger of over-harvesting the wildlife and fishery resources if they are permitted to hunt and fish. The proposed Windigo Site for the power station is known as an important fishing spot for the local natives (Beardy, personal communication 1982). At present, the location of the construction camp is not known. Camp site selection must take into consideration existing fishing activities and sensitive fish habitats.

Construction of the generating facility is not expected to adversely effect trapping activities at Muskrat Dam Lake. Construction will take place during summer months so there should be no widespread disturbance to furbearers during the winter season.

Consultation with the community, strict control of hunting and fishing by in-migrants, and reasonable construction and management practices are some of the preventative measures that have been practised in similar situations to control the potential problems.

2.3.2 OPERATION PHASE

The overall consequence of the hydro project during the operation phase would be positive, provided many of the potential adverse impacts resulting from the construction phase are carefully managed and monitored with precautionary measures. It is anticipated that any disturbance and social consequences resulting from the construction of the project would be short-lived. The long-term social consequence of the hydro project should improve the standard of living of the community.

Native homes would have electricity for the first time in the community. The potential exists for the expansion of existing industries (fishery and forestry) and new industries (country food harvesting) can be made viable, when inexpensive energy is made available. This means improved economic and employment opportunities and diversification of the community's economic base, thereby strengthening the community's self-reliance capability. The result will be a further improvement in the standard of living.

The long-term aspiration of the community is to improve its economic base and its standard of living, and its desire to preserve the integrity of the environment is very strong. It is expected that operation of the power plant because of its low employment requirements will have minimal impact on the harvesting of renewable resources in the area.

The proposed power right-of-ways are unlikely to provide new access to previously inaccessable areas since most areas within 7 km of the community have probably been trapped for many years. Hence, it is not expected that either of the transmission corridors would have a major impact on trapping activities.

2.3.3 CONCLUSIONS

It is believed that the relatively large size of the estimated in-migrant labour force (20 or more individuals) required during the project construction could impose a number of social consequences on the existing native community.

Because of the isolated nature of the community and its traditional culture it is possible that tensions could arise between the in-migrant workers and local natives which may have an adverse impact on the community's lifestyle. Hence, it is considered that it may be beneficial to situate the in-migrant work camp distant from the community and prohibit workers from visiting the community.

Since the project will only be of short duration it is considered that contacts between the in-migrant male labour force and the family-oriented native community may be of insufficient duration to result in positive effects.

The higher wages offered by the project will attract local labour. Negative impacts such as local inflation, job discrimination, unfair competition, and post-project depression at the loss of temporary high incomes may occur. Direct involvement of the native community in all phases of the project, from planning through operation in conjunction with access to family counselling and responsible monitoring of community impacts will assist to mitigate negative impacts.

The native community is very dependent on the available natural resources of their environment. Consultation with the community to control hunting and fishing by in-migrant workers, and the use of responsible construction and management practices are required to avoid sensitive areas and to control potential problems.

In general, it is considered that any negative impacts resulting from the power development will be of short duration. The positive long-term benefit of the hydro project will be to improve the overall standard of living of the community, increasing self-reliance, thereby increasing the opportunity to attain long-term aspirations.

2.4 HERITAGE RESOURCES

2.4.1 CONSTRUCTION PHASE

It is mentioned in Section 135 that the Muskrat Dam Lake environs has high archaeological potential. Archaeological sites in Northern Ontario are located at the water's edge. Thus, any excavation on river banks, no matter how minute, could disturb or have a damaging effect on unknown archaeological resources. The Ontario Ministry of Citizenship and Culture, Archaeology and Heritage Planning Branch, based on existing knowledge of the area, recommends that an intensive survey and possibly subsequent mitigation by undertaken in the project area. (Rajnovich, personal communication 1982). Two potential areas of high sensitivity are the power station site and the location of the submarine cable crossing, where excavation works would be undertaken near the river or on the river banks. The construction camp site and the transmission line corridor should also be surveyed once their locations are selected.

The power project involves no control dam or reservoir. Thus, change in lake water levels will not occur as a result of the hydro power generation, and no damage to potential archaeological resources due to the water level change is expected.

2.4.2 OPERATION PHASE

Assuming adequate site investigation is carried out on heritage resources prior to construction, no adverse impact on the resources is anticipated during the operation phase of the project, as there will be no changes to the site locations of facilities or the water levels of the lake during operation.

2.5 IMPACTS ON FISHERIES AND AQUATIC BIOLOGY

2.5.1 SILTATION

.1 Headrace Construction

The construction of a headrace canal across the small peninsula of land at the proposed hydro site should produce a negligible amount of silt-size material, since the surficial geology of the area consists almost entirely of metamorphic bedrock. Although some finer materials may be produced during construction, these would probably be inconsequential relative to the natural silt load and turbidity present in the Severn River and Muskrat Dam Lake.

Walleye, whitefish, suckers, and pike are known to migrate upstream from Muskrat Dam Lake and spawn in the Windigo River below the rapids near the hydro site (S. Beardy personal communication 1982). The Windigo River is much less turbid than the lake or the Severn River, (McDonald, personal communication 1982) and appears to be an important spawning habitat. Nevertheless, even under these circumstances construction would have negligible impact on spawning because of the predominance of bedrock in the area and an absence of silt-producing material. The nature of the project and its location suggests no specific timing constraints would be required to protect spawning fish, if they are present, from siltation impacts. A possible exception to this may be impacts associated with blasting. Shock waves generated by blasting near known spawning habitat could disrupt spawning activity. This potential could be mitigated by restricting near-shore blasting to after completion of the spring spawning season.

.2 Submarine Cable

The laying of a submarine cable across the Muskrat Dam Lake should pose no siltation hazard to fish in the lake. The lake is naturally turbid and cable laying activities should not create siltation effects that are discernable from ambient conditions. Fish in the lake are tolerant to the turbid environment thus special timing or construction constraints to avoid siltation impacts would not be required.

2.5.2 DISCHARGE OF WASTE MATERIALS

Construction activities near water can result in toxic and/or non-toxic waste materials being accidentally or intentionally discharged into nearby waterbodies and watercourses. Such discharges could include: gasoline, diesel fuel, oil, cement, sewage, creosote and other solids and liquids associated with construction. These substances can adversely affect aquatic life, thus their use and disposal must be stringently controlled. There will be opportunities during the construction of the Muskrat Dam powersite for potentially toxic materials to find their way into the Windigo River. The most probable problem substances would be wood preservatives, petroleum hydrocarbons used for fuel and maintenance of construction vehicles and concrete used in headrace and power station construction. Sewage from temporary sanitary facilities is also a potential source of water pollution.

The impact of potential pollution sources can be mitigated by ensuring that concrete storage, vehicle maintenance and sanitary facilities are maintained a safe distance from the river and in areas where accidental spillages can be contained. This is particularly important because bedrock at the surface will permit any polluted runoff to quickly reach the river. These concerns must be tempered by the small scale and short duration of this project which will result in only limited amounts of potentially hazardous materials being on site. River flows would also assist in rapidly diluting any toxic materials that might inadvertently reach the river, because of large water volumes relative to the small amount of potential pollutants that may be on site. Adequate spill contingency planning would also minimize the risk of waste or toxic materials entering the river.

The possibility of discharge of hazardous materials should be a minor consideration during this project if adequate waste management procedures are developed prior to undertaking construction.

2.5.3 STREAM FLOW AND WATER LEVELS

The Muskrat Dam hydro project is expected to require, at maximum, only 21 per cent of the annual minimum flow in the Windigo River. This small diversion of water is expected to have a negligible impact on fish movements in the river and would only affect water levels in the short distance of river through the rapids, where few fish would be found. No project constraints need be considered with regards to river flows and water levels, as project-induced changes would be within the normal range of variability.

2.5.4 FISH MORTALITY IN HEADRACE CANAL

Some mortality may occur to fish in the Windigo River which pass through the turbines during the operational phase of the project. Trash racks will mitigate against larger fish finding their way into the headrace canal; however, smaller sized fish could pass through the trash racks and later the turbine via the headrace canal and penstock.

Comprehensive reviews of both published and unpublished research on turbine-induced fish mortality can be found in Bell et al. (1067) and Montreal Engineering Company, Limited (1979). In general, a variety of factors produce mortality during turbine passage:

1) mechanical damage dur to contact with fixed or moving equipment;

2) pressure-induced damage due to exposure to low pressure conditions within the turbine;

3) shearing action damage due to passage through areas of extreme turbulance; and

4) cavitation damage due to exposure to regimes of partial vacuum.

Eicher (1970) found that fish mortalities in turbines ranged from 5 to 100 per cent. Bell et al. (1967) found that for Kaplan and Francis type turbines, highest fish survival occurred at the point of highest total turbine efficiency. In another study, Bell (1974) stated fish survival through turbines at low head installations could be 90 per cent or greater.

Two Francis-type turbines will be installed at the Muskrat Dam hydro site. Experience suggests that limited turbine-induced fish mortality can be expected, but the low head design of the project would ensure a potentially high survival rate for any fish passed through the turbines. The low headrace canal velocities will also allow stronger swimming smaller fish to avoid entrapment.

2.5.5 CONCLUSIONS

On the basis of the limited information available, it would appear that there are no major threats to the fish populations inhabiting Muskrat Dam Lake or the Windigo river, from the Muskrat Dam mini-hydro development. No constraints appear necessary at either the construction or operational phases of the project with the one possible exception of timing constraints on blasting. It is recommended that one site visit be undertaken to verify the predictions on low impact stated in this preliminary environmental assessment.

2.6 IMPACTS ON WILDLIFE

2.6.1 CHANGES TO HABITAT BY CLEARING

The project area is remote from any large centre of population or major resource harvesting developments. Habitat for big game, small game and fur bearers is virtually unlimited and, when the native trapping and subsistence hunting is considered, it is highly probable that the available habitat is under-utilized by the community of Muskrat Dam Lake. Clearing for the powerhouse, headrace and transmission line will result in minor habitat alterations but these will be insignificant in the local and regional context. Where the transmission line right-of-way traverses dense stands of conifers, habitat diversity will be improved slightly by the availability of grasses and low shrubs along the corridor. This diversity will be exploited by large and small mammals and also birds. Nevertheless, it is considered that the extent of habitat changes will be so small relative to the variety of habitats available that the effect on local wildlife will be insignificant.

2.6.2 IMPROVED ACCESS ALONG TRANSMISSION LINE

The proposed transmission corridors will extend between 7 and 15 km from the power plant to the community. Less than one kilometer of the 7 km corridor will be a submarine cable under Muskrat Dam Lake. The remainder of the corridors are generally within one kilometer of the

lake shore, which is readily accessible by boat in summer or by snow machine or on foot in winter. The potential impact created by the marginal improvement of access along the transmission corridor is expected to be negligible as the area of the corridor is presently readily accessible at all seasons of the year.

2.6.3 DISTURBANCE BY MAN AND EQUIPMENT

The greatest potential for disturbance of wildlife will occur during the period of moving equipment and supplies to the powerhouse site, and during construction. Construction equipment and supplies will be transported over a winter road from Windigo Lake and this may provide a periodic minor disturbance over one winter season to big game and furbearers nearby the route. During construction, the noise associated with blasting and the operation of heavy equipment will undoubtedly cause sensitive species such as most furbearers to vacate the area until the disturbance ceases. This activity will take place over one summer and the impact should be temporary. Operation of the powerhouse and transmission facilities will not entail any major disturbance to local wildlife species or their habitats.

2.6.4 CONCLUSIONS

The small magnitude of the proposed development, with its short construction schedule will have an insignificant impact on both local wildlife or available wildlife habitat, which is essentially unlimited in the region.

2.7 GEOBOTANICAL IMPACTS

2.7.1 CLEARCUTTING FOR TRANSMISSION CORRIDOR

Clearing of trees and tall shrubs along the transmission corridor will be the greatest project impact on vegetation. Clearing is necessary so that vegetation will not interfere with installation of the power poles and conductors, or operations of the line. Soil erosion concerns usually require that vegetation cover be kept as complete as possible but consisting of grasses or low shrubs which will stabilize the available soils without interfering with the conductors. The right-of-way is expected to be 10 to 15 meters in width and between 7 and 15 km in length depending on the corridor alternative selected.

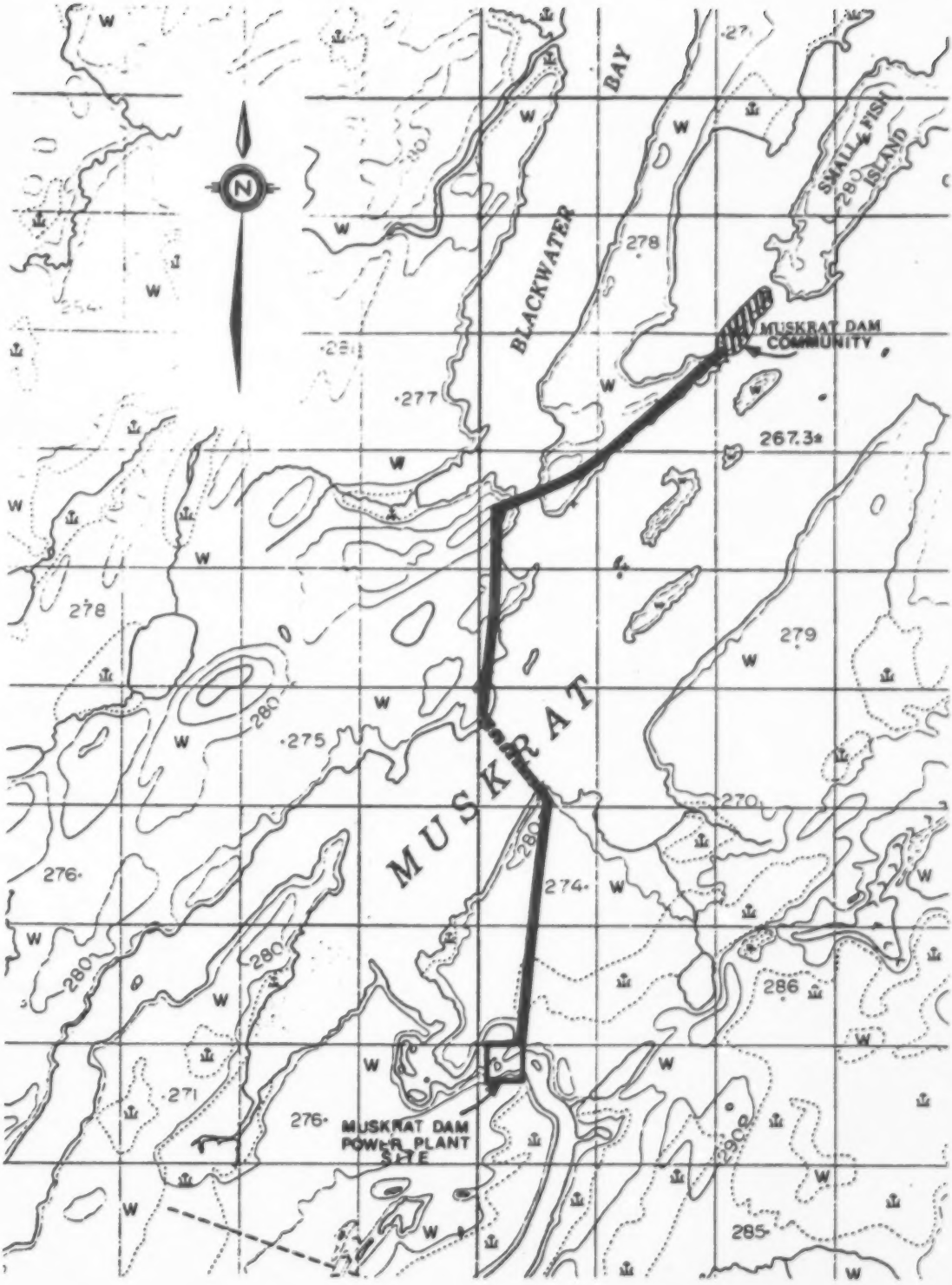
The most noticeable contrast will be seen where the cleared corridor traverses dense coniferous stands.

2.7.2 SPRAYING FOR BRUSH CONTROL

Herbicidal control of broad-leafed and coniferous vegetation is a common maintenance practice along the corridors in North America and is generally considered cost effective. Depending upon the type of herbicide used, a variety of environmental contamination problems can be anticipated due to the transport of the herbicieds by surface water or groundwater runoff. In northern areas, where vegetation growth rates are slowed by short, cool growing seasons and other adverse conditions, herbicial control may be an unnecessary expense. Brush control could be done once every five to ten years by a small crew of local workers working in the winter with axes or chain saws to selectively cut the taller trees and shrubs which threaten the integrity of the conductors. This would minimize vegetation damage and the potential hazards related to herbicides, while maintaining a dense ground cover and protecting the transmission facilities.

2.7.3 CONCLUSIONS

No significant impacts on vegetation are anticipated from this small scale development although it is recognized that there is a potential problem if herbicides are used to control vegetation along the right of way. It is recommended that a "winter works" program be instituted once every five to ten years, as necessary, to selectively clear problem trees and shrubs from the right of way using local residents with axes and chain saws. This program would be particularly beneficial from a public relations standpoint because income would be provided to the community and no "toxic materials" would be released to the local environment.

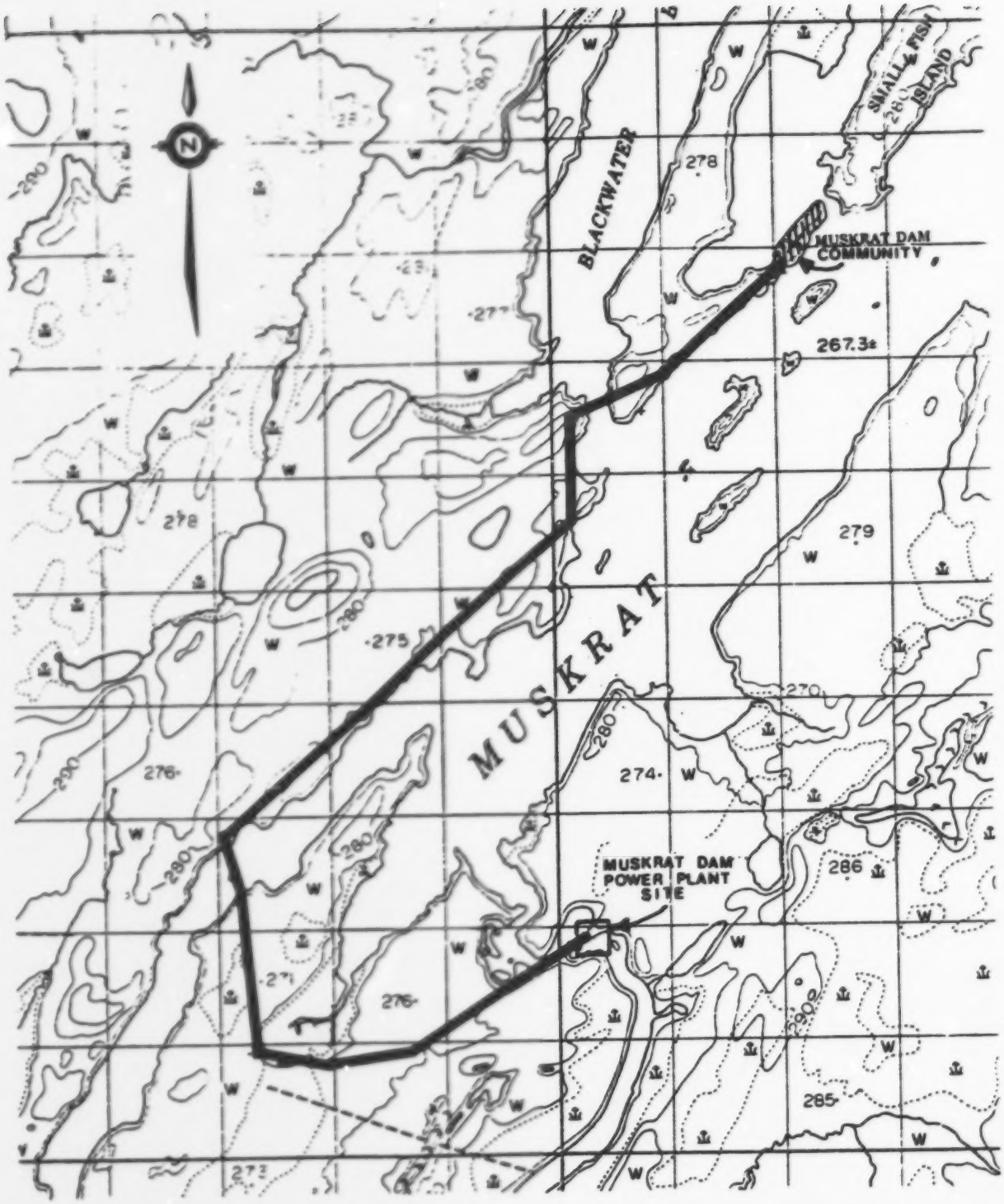


TRANSMISSION LINE
SUBMARINE CABLE

FIGURE 2-1

ONTARIO MINISTRY OF ENERGY
MUSKRAT DAM

TRANSMISSION LINE ALIGNMENT
ALTERNATIVE I



TRANSMISSION LINE

FIGURE 2-2

ONTARIO MINISTRY OF ENERGY
MUSKRAT DAM

TRANSMISSION LINE ALIGNMENT ALTERNATIVE II

3.1 FURTHER STUDIES

The analysis presented in Part 2 on potential impacts is based on limited information and a preliminary overview examination effort. A number of areas, due to their particular sensitivity and local importance, are recommended for further study. Generally, the required studies can be completed in a very short time frame and at minimal expense to the proponent of the project. These are briefly discussed below.

3.1.1 COMMUNITY CONSULATATION

Direct community involvement should be initiated in conjunction with any further planning effort regarding the proposed hydro project. This process would be beneficial to both the proponent and the community. The proponent, with direct input from the community would be able to design the project in the most cost-effective way to meet the present and future requirements of the people. The community, with first-hand knowledge of the various design and constraint aspects of the project, would be able to better prepare itself in priorizing their community goals and objectives so as to avoid adverse situations and to optimize the benefits.

3.1.2 EMPLOYMENT OPPORTUNITIES

Further refined information concerning the employment requirements of the project will have to be provided prior to commencing the project. This includes job description, skill requirement, wage rate, duration of employment and training possibilities. All of these are relevant to the estimation of participation levels of local labour force, the level of in-migration and the level of job displacement. This knowledge is necessary for effective job-skill matching, prevention of job discrimination and optimal utilization of local manpower. Determination of the project employment requirements will permit more effective management of social impacts on the local community.

3.1.3 SITE LOCATION ANALYSIS

The locations of the construction camp and the power plant should be examined to identify sensitive areas and avoid or minimize impacts. A site visit to survey fishery resources is recommended to confirm that the anticipated impacts from the proposed development will be negligible.

3.1.4 ARCHAEOLOGICAL RESOURCES

A site visit is highly recommended by the Ontario Ministry of Citizenship and Culture, responsible for the Provinces' heritage resources to identify areas of sensitive heritage resources which may be affected by the project and to develop mitigative measures as required. The project environment is deemed highly sensitive to disturbances.

3.1.5 COMMUNITY MONITORING

A monitoring committee should be established by the contractor selected for the project. A researcher, responsible to the community, through the monitoring committee, would report on the various environmental and socio-economic aspects of the project throughout its duration from the planning phase through construction to the initial period of operation. The planning phase monitoring is deemed most crucial as it provides the basis against which mitigation measures could be effectively implemented as construction and operation proceed.

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